70 WATT INTEGRATED STEREO AMPLIFIER

MODEL

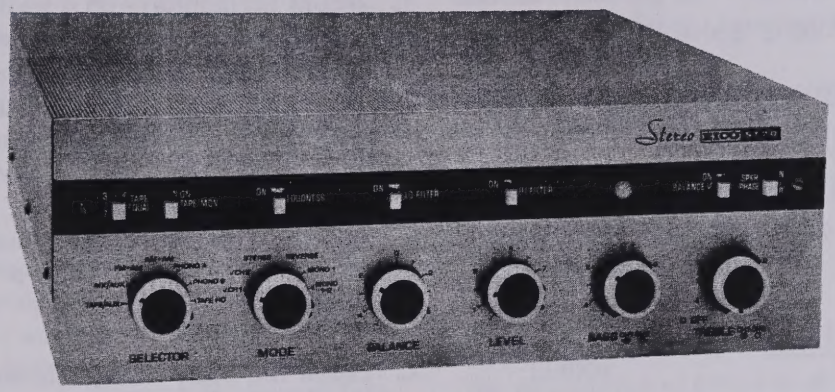
ST 70

INSTRUCTION MANUAL

ST 70-I

ELECTRONIC INSTRUMENT CO. INC.
3300 NORTHERN BLVD., L. I. CITY 1, N. Y.

70 WATT INTEGRATED STEREO AMPLIFIER



GENERAL DESCRIPTION

The EICO Model ST-70 is a complete high fidelity stereophonic control center and a pair of 35-watt amplifiers, all on one chassis. With it, you can select, preamplify, and control any stereophonic or monophic source and feed it through the self-contained dual 35 watt amplifiers to a stereo pair of speaker systems. Provision is made for operating a center speaker directly from the ST-70.

FEATURES

1. Provision for two stereo phono cartridges to be connected. Permits the use of both a turntable and a record changer in the installation. One pair presents 47KΩ load and the other pair 100KΩ load, to cover most popular cartridges. RIAA equalization.

2. Provision for connecting stereo tape heads. Either NARTB equalization for 7 1/2 ips, or standard equalization for 3 3/4 ips can be selected on the front panel.

3. High level input pairs for multiplex adaptor, preamplified and equalized tape, FM tuner, and AM tuner.

4. Separate level and balance controls. Null-type balance checking circuit.

5. Switched high and low frequency filter circuits permit elimination of rumble or scratch.

6. Switched loudness compensation.

7. Tape monitor switch.

8. Speaker phase selector switch.

9. Feedback equalization, with feedback around both preamplifier stages. High overload point.

10. Bass and treble tone controls are of the variable inflection point, feedback type, for exceptionally low distortion and the most desirable control characteristics. These controls do not affect the volume or interact with each other, and boost or cut at the extremes of the audio range do not affect the mid-range.

11. Separate filament windings and hum balance controls for each channel permit an optimum hum balance for each channel, rather than a compromise for both channels.

12. Unused inputs grounded by SELECTOR switch to eliminate cross-talk — except for TAPE inputs, since some tape machines are adversely affected if playback outputs are grounded during recording.

13. Provision for feeding a center speaker directly from the ST-70.

14. Power amplifier circuit incorporates a triode voltage amplifier direct-coupled to a dual triode cathode-coupled phase inverter.

15. 7591 output pentodes, conservatively operated in push-pull output stages with fixed bias. DC balance controls, and controls for adjusting the fixed bias are provided.

SPECIFICATIONS

POWER OUTPUT: 70 watts total; 35 watts each channel continuous sine wave power

IM DISTORTION (60 & 7000 CPS at 4:1): 1% at 35W each channel
HARMONIC DISTORTION: Less than 1% 25-20,000 cps within 1db of 35 watts each channel

FREQUENCY RESPONSE: ±0.5db 18-43,000 cps at 35 watts each channel, ±1db 9-60,000 cps at 1 watt each channel

INPUT	SENSITIVITY	INPUT IMPEDANCE
Phono A	4Mv	100KΩ
Phono B	4Mv	47KΩ
Tape Head 3 3/4	1.4Mv	1MΩ
Tape Head 7 1/2	2.15Mv	1MΩ
FM	480Mv	500KΩ
AM	480Mv	500KΩ
Multiplex	480Mv	500KΩ
Tape	480Mv	500KΩ

TONE CONTROL RANGE: ±15db at 50 cps and 10kc

DAMPING FACTOR: above 6

SPEAKER CONNECTIONS: 4, 8, 16Ω

TAPE OUTPUT IMPEDANCE: 400Ω at 20kc when using low level inputs; same as the output impedance of the source when using high level inputs

TUBES: 3-12AX7, 2-12DW7, 2-6SN7GTB, 4-7591, 1-GZ34 rectifier

POWER SOURCE: 117V, 60 cps

POWER CONSUMPTION: 125 watts

CONVENIENCE OUTLETS: 1 controlled by power switch, 1 not switched
FUSE: 3 amperes
SIZE (HWD): 5 1/8" x 15 7/8 x 15"
WEIGHT: 40 lbs.

CABINET INSTALLATION

GENERAL

1. Mount horizontally on a well-braced shelf. The stock thickness of the wood panel may not exceed 3/4".

2. Do not remove feet for mounting. Air must be allowed to enter through the perforations in the bottom plate to avoid overheating.

3. Any shelf above the unit must be spaced away at least 3 inches. Allow at least a 1 1/2" clearance on each side of the unit.

4. Leave the back of the cabinet entirely open.

PREPARATION OF UNIT

1. Turn unit over and loosen the front and rear pairs of screws (4 in all) that fasten the bottom plate to the side pieces. Remove the center pair entirely. Then turn the unit back right side up.

2. Remove the 6 screws, one on each side, that fasten the cover to the side pieces. Remove the cover and set aside.

3. On the top side of the chassis, loosen all 6 screws (3 on each side) that fasten the chassis to the side pieces.

4. Push both side pieces back as far as they will go. The screws that have been loosened will move from the front to the rear ends of the slots in the chassis and the bottom plate. Then re-tighten all the screws that have been loosened. Check to see that all the tubes are properly seated in their sockets, and then replace and re-fasten the cover to the side extrusions.

5. Remove all the knobs from the control shafts, and then remove the 4 screws, (2 previously concealed by knobs and 2 in the recessed area) that fasten the panel to the chassis. Lift the panel out over the control shafts and set it aside. The unit is now prepared for cabinet installation.

CH. 2 Low Level Inputs	CH. 2 High Level Inputs
PHONO A 2	AM 2* (See note)
PHONO B 2	Multiplex 2
TAPE HEAD 2	TAPE 2

All high level inputs are provided the same gain and flat frequency response. Low level inputs are provided much higher gain and the prescribed gain-frequency characteristics of R1AA for phono and NARTB for tape head.

Monophonic sources, such as FM tuner, AM tuner, or monophonic phono cartridge, are plugged into Channel 1 inputs. Stereophonic sources, such as stereo phono cartridge, stereo tape heads, or FM, Multiplex (MX) adaptor, are plugged in as follows: left channel into channel 1 inputs; right channel into channel 2 inputs.

*Input AM 2 has been provided due to the possibility of AM-AM stereo. AM 1 is the normal AM tuner input.

Setting the SELECTOR switch to FM-AM and the MODE switch to STEREO or REVERSE takes care of feeding two normally monophonic channel 1 inputs (FM tuner and AM tuner) one to channel 1 and the other to channel 2 for FM-AM simulcast stereo.

PHONO

The PH. A input jacks 1 & 2 and the PH. B input jacks 1 & 2 permit the use of two magnetic cartridges in your system. One cartridge can be a stereo type and the other monophonic, or both can be stereo. One cartridge can be in a turntable, and the other in a record changer or an inexpensive phono for children's use. A monophonic cartridge is plugged into the channel 1 input only.

When playing a monophonic record with a stereo cartridge, set the MODE switch to the MONO 1-2 position, specifically intended for this purpose. In the MONO 1-2 position, the channel 1 and 2 inputs are fully blended internally, and the blend is fed to both amplifiers. The purpose here is to cancel extraneous vertical noise components in the cartridge output.

When playing a monophonic record with a monophonic cartridge, set the MODE switch to MONO 1, the normal monophonic position at which the channel 1 input is fed to both amplifiers.

The load presented to the cartridge by the PHONO A inputs is 100KΩ. The load presented to the cartridge by the PHONO B inputs is 47KΩ. The choice of load impedance permits accommodation of most popular cartridges. Most popular cartridges, including all Shure and the Pickering 381A require 47KΩ load. The Pickering 380A, however, requires 100KΩ load.

If the Weathers C501-D cartridge is used, connect a 180KΩ resistor in series followed by a 33KΩ resistor in shunt, across each output. Plug into PHONO A inputs. This network avoids overloading the pre-amplifier inputs.

TAPE HEAD

The TAPE HEAD 1 & TAPE HEAD 2 input jacks permit the connection of a tape deck having no playback preamplifiers to the unit. The tape head should be the conventional high impedance, high output type normally supplied in decks without playback electronics. If the head is of the stereo type, connect the upper track output to TAPE HEAD 1, and the lower track output to TAPE HEAD 2. If the head is of the monophonic type, connect the output to TAPE HEAD 1. The load presented to the tape head by each input is 1 megohm. Choose the proper equalization for the tape playing speed, using the TAPE EQUAL switch on the front panel.

FM TUNER

The FM 1 input jack is for connection of an FM tuner.

AM TUNER

The AM 1 input jack is for connection of an AM tuner. Do not use AM 2 for this purpose.

FM MULTIPLEX ADAPTOR

The MX 1 and MX 2 input jacks permit the connection of an FM Multiplex adaptor. Any adaptor will provide a left channel output and a right channel output. The left channel output is connected to MX 1 and the right channel output to MX 2.

TAPE

The TAPE 1 and TAPE 2 input jacks permit the connection of a tape machine complete with playback preamplifiers. If the machine provides stereo playback, connect the upper track output to TAPE 1, and the lower track output to TAPE 2. If the machine is of the monophonic type, connect the output to TAPE 1.

PREPARATION OF CABINET

1. Two templates are provided, one for the cabinet shelf and the other for the cabinet panel. The shelf template is used to locate exactly two holes that are to be drilled in the shelf. The panel template is used to locate exactly the required rectangular cut-out. The two templates must be used together as indicated, as there is an exact relationship between the locations of the shelf holes and panel cut-out.

2. To use the shelf template, cut it or fold it back exactly along the dashed line that corresponds to the panel thickness. Remove the shelf from the cabinet and line up this dashed line on the template with the front edge of the shelf, positioning it also along the edge to leave at least 1 1/2" clearance on each side. Tape the template in position and use a center punch to mark the centers of the two holes to be drilled. If the shelf can not be removed, place the template in a similar manner on the top side of the shelf if there is room to drill from the top side, or on the under side of shelf if there is only room to drill from the under side. If the template is used on the underside of the shelf, mark the rear edge of the shelf at the points where the extended heavy lines on the template hit the rear shelf edge. After the holes are center-punched, remove the template and drill carefully through the punched centers to a diameter of 1/4". If the shelf has been removed for the drilling operation, now re-mount it. Finally, replace the shelf-template in exactly its former position on the top-side of the shelf and tape it down. If the shelf template had been used on the underside of a stationary shelf, now place it on the top-side of the shelf using the marks on the rear edge of the shelf previously made. (In the latter case, accuracy may be improved by cutting the two holes out of the shelf-template with a razor blade and then lining up the holes in the shelf template with the holes in the shelf).

3. To use the panel template, cut it or fold it back exactly along the dashed line. This dashed line corresponds to the junction of the top side of the cabinet shelf and the interior side of the wood panel. Position the panel template against the interior side of the wood panel so that the dashed line rests against the shelf and the two heavy vertical lines in the panel template meet with the two heavy horizontal lines in the shelf templates. Tape the panel template down and use a center-punch to make the centers of the four 3/8" holes in the four corners of the rectangular cut-out shown on the template. Now remove both templates and drill carefully through each of the four punched centers to a hole diameter of 3/8". On the front side of the wood panel scribe a rectangle externally tangential to the four drilled holes. Check the height and width of the rectangle against the panel template dimensions. These dimensions should not be exceeded. Now carefully cut out the rectangle with a sabre saw, using a small blade to start accurately in the 3/8" holes. After the cutting operation, any rough spots or excess material along the edges of the cut-out may be removed with a file. Finally, brush or blow out all chips and sawdust.

MOUNTING THE UNIT

1. Insert the unit from the rear of the cabinet, carefully guiding the controls through the panel cut-out. Center the unit in the cut-out and re-mount the panel with the four screws previously removed.

2. From the rear of the cabinet, pull the amplifier toward you gently, until the front panel is flush against the wood panel.

3. Now place 5/8" flat washers against the heads of the two #8 x 1 3/4" screws provided and insert them from the bottom side of the shelf into the two holes drilled previously. It may be necessary to shift the unit slightly to the left or right in order to afford clear access for the screws. When both screws have caught, tighten them to secure the unit to the shelf.

4. Replace the knobs previously removed on the control shafts.

INPUT CONNECTIONS

Channel 1 has 7 inputs and channel 2 has 6 inputs, one of which there is no use for at the present time (AM 2).*

The channel 1 inputs are identified by the suffix "1" and are as follows:

CH. 1 Low Level Inputs	CH. 1 High Level Inputs
PHONO A 1	FM 1
PHONO B 1	AM 1
TAPE HEAD 1	Multiplex 1
	TAPE 1

The channel 2 inputs are identified by the suffice "2" and are as follows:

Set the speakers together, including the center speaker if you are using one. Listen to a monophonic source with plenty of bass material through both channels, and all speakers, at once. Temporarily disconnect one lead going to the center speaker. Now reverse the connections to one outside speaker. If the bass is fuller, the two outside speakers are now in phase. If the bass is thinner, restore the original connections to this outside speaker. Now re-connect the lead previously removed from the center speaker. If the bass is fuller, the center speaker is in phase with the outside speakers. If the bass is thinner, reverse the connections to the center speaker.

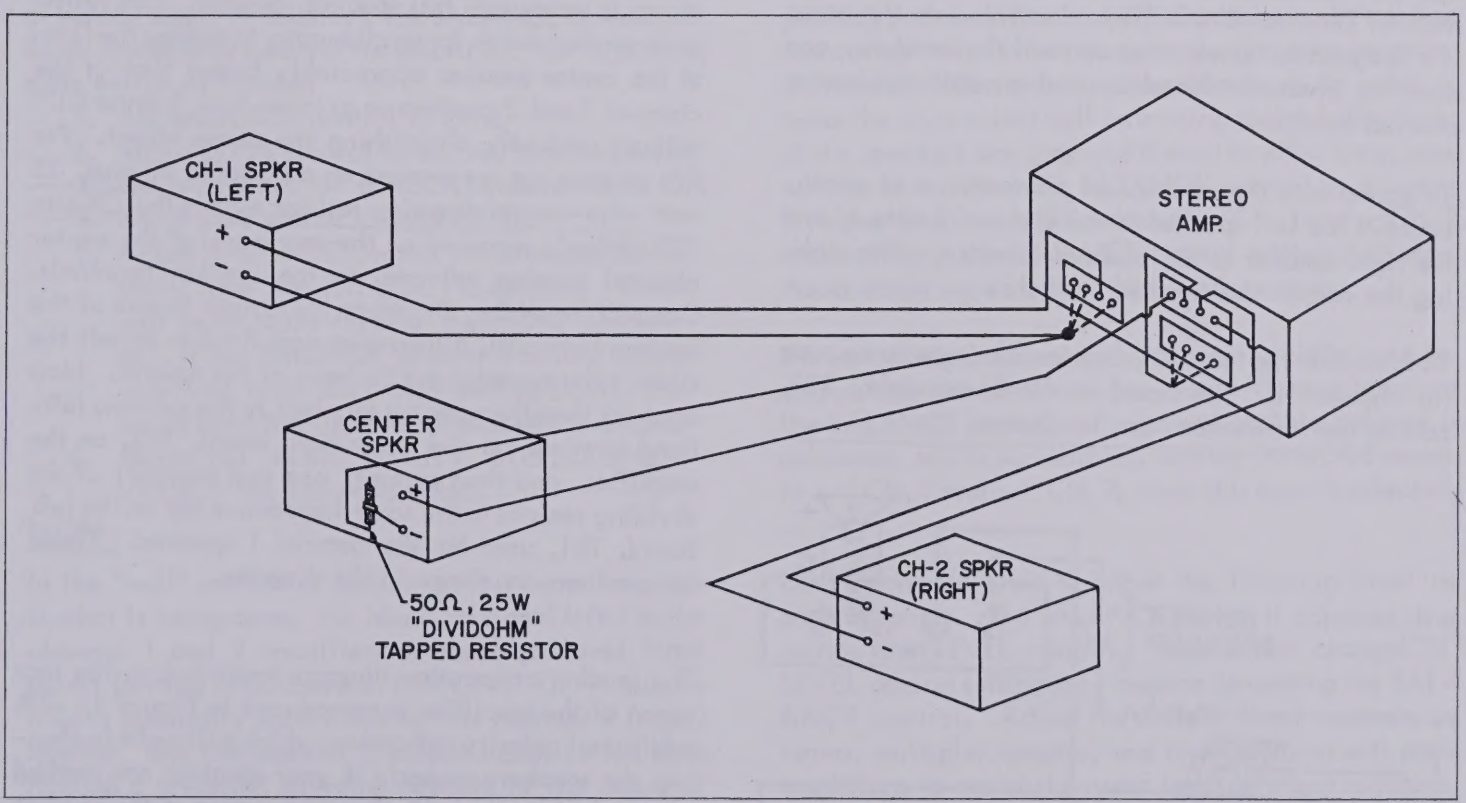
NOTE: We do not mean to give the impression that a center channel speaker is normally necessary in a stereo installation. We consider it, rather, to be a convenient facility in the case that the channel 1 and 2 speakers have to be spread apart more than the normal 8 to 10 feet, or that, with normal spacing, listening at close quarters is often necessary. Under these circumstances the sound from the channel 1 and 2 speakers may become disassociated, resulting in a phenomenon known as "hole-in-the-middle". The center channel speaker is a remedy for this situation.

AC POWER CONNECTIONS

Plug the line cord into a 117VAC, 60 cps power line outlet only. A DC power source will cause severe damage to the unit.

Two convenience outlets are provided on the rear apron, one switched and one unswitched. The unswitched outlet should be used with record changers, turntables, or tape decks (devices which can sometimes be harmed if turned off simply by removing power), if it is not convenient to plug them directly into the power line. The switched outlet is for use with tuners. A cube tap may be used if more than one connection is to be made to an outlet.

A 3 amp fuse is provided on an extractor post mounting on the rear apron. This fuse protects only the amplifier, not any equipment plugged into the switched convenience outlet.



SPEAKER CONNECTIONS FIGURE 2

OUTPUT CONNECTIONS

TAPE RECORDER

The TAPE OUT 1 & TAPE OUT 2 jacks are intended for feeding signals out to the "line" recording inputs of a tape recorder. These are independent outputs for channel 1 and channel 2, respectively. They are unaffected by the LEVEL, BALANCE, BASS, TREBLE, HI FILTER, and LO FILTER controls.

SPEAKER CONNECTIONS

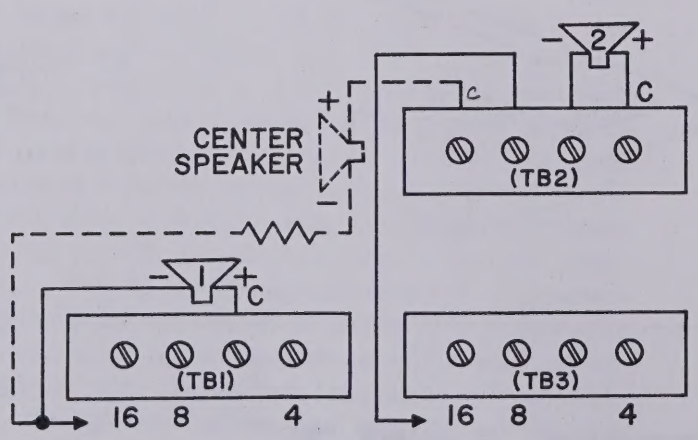
WARNING: Do not operate the amplifier without first connecting speakers to the speaker connection terminals, exactly as described below.

Every speaker has a rated impedance, which may be 16, 8, or 4 ohms. For an amplifier to provide rated power output with rated distortion, the speaker used with it must be connected to the output transformer tap corresponding to its impedance.

On the rear apron of the unit, there are three 4-connection Terminal Boards (TB). Imprinted on the apron is a diagram for connecting up to three speakers, one each for channels 1 and 2, and an optional center channel speaker.

To agree with the established conventions of stereo, connect the left speaker to the channel 1 output, and the right speaker to the channel 2 output, after reading the connection information below.

The board at the left, TB1, carries the impedance taps for channel 1. The board at the lower right, TB3, carries the impedance taps for channel 2.



SPEAKER TERMINALS FIG. 1

The left board, TB1, carrying the channel 1 impedance taps (16, 8, 4Ω), also includes the common terminal (C) for channel 1. The channel 1 speaker is connected to this common terminal C and the appropriate channel 1 impedance tap, as shown.

The lower right board, TB3, carrying the channel 2 impedance taps (16, 8, 4Ω), must not be used for connecting the channel 2 speaker. The upper right board, TB2, provides the connection terminals for the channel 2 speaker. As the diagram shows, the channel 2 speaker is to be connected between the right-hand pair of terminals on board TB2. Note that the terminal at the extreme right is marked "C", this being the common terminal for channel 2.

To complete the connection of the channel 2 speaker, a jumper wire must be connected between the third terminal from the right on the upper right board, TB2, and the appropriate impedance tap on the lower right board, TB3, as shown in the diagram.

There is a third speaker shown in the diagram, labelled CENTER SPKR. (OPTIONAL). A resistance symbol is shown in series with this speaker, as well. This resistance symbol stands for an attenuator to reduce the level of the center speaker appreciably below that of the channel 1 and 2 speakers so as to produce "center fill" without markedly diminishing the stereo effect. For this purpose we recommend an adjustable 50 ohm, 25 watt wire-wound dropping resistor such as the Ohmite "Dividohm", mounted on the rear panel of the center channel speaker adjacent to the speaker terminals. Connect the sliding divider on the resistor to one of the speaker terminals, allowing enough slack to permit the slider to be moved along the body of the resistor. Now connect the other speaker terminal to the extreme left-hand terminal on the upper right board, TB2, on the amplifier, and then connect one end terminal of the dividing resistor to the same impedance tap on the left board, TB1, used for the channel 1 speaker. These connections are shown in the diagram.

The speaker connection diagram imprinted on the rear apron of the amplifier is reproduced in Figure 1, with additional polarity indications which will assist in phasing the speakers properly if your speakers are marked as to polarity. A physical representation of the speaker connections is given in Fig. 2. If your speakers are not marked as to polarity, use the phasing method given below. Have the SPKR PHASE switch set at N throughout.

TAPE EQUAL slide switch: Used to provide the proper playback equalization for the tape speed used, when a tape deck without playback pre-amplifiers is connected to the TAPE HEAD inputs of the amplifier. The 7 1/2 ips equalization is in accordance with the NARTB standard. The 3 3/4 ips equalization is in accordance with industry standards. The tape speed equalization selected is in effect only when the SELECTOR switch is set at the TAPE HD. position.

BALANCE Control: Used to achieve equal left and right side program levels in stereo. Effective in mono to center the apparent source between the speakers. Neither channel amplifier is favored (as to gain) at the zero setting (mid-rotation). As the control is turned clockwise from zero, the channel 2 (right) speaker is made louder and the channel 1 (left) speaker is made softer, while the overall level remains about the same. As the control is turned counter-clockwise from zero, the channel 1 (left) speaker is made louder and the channel 2 (right) speaker is made softer, while the overall level remains about the same.

BALANCE ✓ (CHECK) Slide Switch: If you have identical left and right speakers (or dissimilar speakers of nearly equal efficiency), the BALANCE control can be set properly by means of the BALANCE ✓ (CHECK) slide switch as follows:

1. Set BALANCE control to zero.
2. Adjust LEVEL control for desired listening level.
3. Set BALANCE ✓ (CHECK) slide switch to ON
4. Set MODE switch to MONO 1.
5. Adjust BALANCE control for minimum sound (null) from the left (CH. 1) speaker. There will be no sound from the right (CH. 2) speaker. If the BALANCE control is turned either direction from the proper setting (null), the sound level from the left speaker will increase.
6. Return the MODE switch to STEREO or REVERSE if the source is stereo.

NOTE:

In the "null" method of balancing just described, this is what is being done. An identical signal is fed to the channel 1 and 2 amplifiers at the high level input points (setting MODE switch to MONO 1). A dummy load is internally substituted for the channel 2 (right) speaker, and the channel 2 output signal is fed back through a precision dividing network to the input of the channel 1 power amplifier (setting BALANCE ✓ switch to ON). The channel 2 output signal is out-of-phase with the input signal to channel 1, and tends to cancel or nullify it. When the BALANCE control is set so that the portion of the channel 2 output signal fed to the channel 1 power amplifier input is equal to the channel 1 signal at this point, almost complete cancellation (null) occurs and the output from the channel 1 speaker is at a minimum.

This method of balancing achieves equality of gain in the channel 1 and 2 amplifiers from the high level inputs to the speaker outputs. The preamplifiers, which are ahead of the high level input, are audibly nearly equal in gain because of feedback. If, upon returning the MODE switch to STEREO or REVERSE after setting the BALANCE control by this method, audible balance is not achieved, the indication is that the sources feeding the amplifier are not equal. If the sources have their own level controls, such as FM or AM tuners or Multiplex adaptors, then these level controls should be set to equal output by successively setting the MODE switch at ✓CH. 1 and ✓CH. 2 while adjusting the source level controls for equal output from each speaker. Once the source levels have been adjusted, the null balancing method described previously will work effectively.

If one speaker is a little more efficient than the other, you may pad down the more efficient speaker by a series resistor up to half the rated speaker impedance (more will unduly deteriorate speaker damping), in order to make the convenient null balancing method effective. If the speakers are grossly different in efficiency, you will have to adjust the BALANCE control by successively setting the MODE switch at ✓CH. 1 and ✓CH. 2, while finding the BALANCE control setting that produces about equal output from each speaker.

If a stereo phono cartridge has a marked difference in output between the two sides, you will have to adjust the BALANCE control setting until audible balance is achieved, while successively setting the MODE switch to ✓ CH. 1 and ✓ CH. 2, when this input is selected.

LEVEL control: Used to adjust the listening level in both channels. The BALANCE control is adjusted after setting the LEVEL control. Substantial changes in LEVEL control setting may require re-setting the BALANCE control. Adjust the output level controls in tuners, multiplex adaptor, and tape machines with preamplifiers, to match the sound level obtained on phono, if possible. If any of the high level sources can not provide high enough output to match phono, simply set this source to maximum output.

OPERATION OF CONTROLS

SELECTOR Switch: Used to select any input or pair of inputs as follows:

POSITION	SOURCE	INPUTS	COMMENTS
TAPE/AUX.	Pre-amplified tape	TAPE 1 & TAPE 2	
MX/AUX.	FM Multiplex Stereo	MX 1 & MX 2	
FM-AM	FM tuner & AM tuner	FM 1 & AM 1	FM only with MODE Sw at MONO 1
AM-AM*	AM tuner	AM 1	Set MODE Sw at MONO 1
PHONO A	Stereo mag. phono cartridge	PH. A 1 & PH. A 2	Set MODE Sw at MONO 1-2 to play mono record
PHONO B	Stereo mag. phono cartridge	PH. B 1 & PH. B 2	Set MODE Sw at MONO 1-2 to play mono record
TAPE HD.	Stereo tape head in deck without preamplifiers	TAPE HD. 1 & TAPE HD. 2	

MODE Switch: Used to select mode of operation

POSITION	OPERATION	COMMENTS
✓CH. 1	CH. 1 input out CH. 1 speaker	For checking left side of stereo program
✓CH. 2	CH. 2 input out CH. 2 speaker	For checking right side of stereo program
STEREO	CH. 1 input out CH. 1 speaker CH. 2 input out CH. 2 speaker	Should normally give left side of program out of left speaker, and right side of program out of right speaker
REVERSE	CH. 1 input out CH. 2 speaker CH. 2 input out CH. 1 speaker	Use if left side of program is coming out of right speaker when set at STEREO
MONO 1	CH. 1 input out CH. 1 & 2 speakers	Use for all mono listening except when playing mono record. Used also for checking balance in Stereo. See BALANCE ✓ operation.
MONO 1-2	CH. 1 plus CH. 2 inputs blended, out CH. 1 & 2 speakers	Used only when playing mono record (with stereo cartridge)

*See note on use of AM 2 in INPUT CONNECTIONS.

TAPE MONITOR slide switch: Useful with complete tape machines (including record and playback electronics) that provide off-the-tape monitoring facilities while recording. In this situation, setting the TAPE MONITOR slide switch to ON permits you to hear the program being recorded directly from the tape.

MAINTENANCE

INSTALLATION PROCEDURES FOR MINIMUM HUM

AC LINE CORDS: Hum can usually be reduced by the following procedure, after all the equipment used with the amplifier is connected to it and plugged in.

1. Turn on all the equipment used.

2. Reverse the amplifiers's AC line cord plug in the wall outlet to see if hum is reduced. Leave it in the position that results in least hum.

3. With the SELECTOR switch, select a particular piece of equipment, and determine the insertion position of its AC line cord plug that results in least hum.

4. Repeat step 3 for every piece of equipment used with the amplifier.

When this is done, proceed to HUM BALANCE adjustments.

HUM BALANCE: Separate filament windings and hum-balance controls are provided for the two channels, so that an optimum hum balance setting can be found for each channel, rather than a compromise setting for both channels. Connect the phonograph and leave it shut-off with the tone arm at rest. Set the SELECTOR to the PH. A or PH. B position depending on which inputs are used. Set the MODE switch at ✓CH. 1, BALANCE at 0, LEVEL at 10, BASS 1 & 2 at 0, TREBLE 1 & 2 at 0 (amplifier turned on). Set all slide switches at "off" (down). Adjust the channel 1 hum-balance control (R-107) with a screw-driver until the hum heard from the channel 1 speaker is at a minimum. Now set the MODE switch at ✓CH. 2, and adjust the channel 2 hum-balance control (R-106) until the hum heard from the channel 2 speaker is at a minimum. See Figure 2 for these locations of R-106 and R-107.

GROUNDING: The cause of phonograph hum may be a metal pick-up arm not grounded to the cable shield (try a good single ground connection to the cable shield from turntable frame, pick-up arm, and cartridge case), direct hum pick-up by the magnetic cartridge from the record player motor (try using a rubber mat on the turntable to increase the separation of the pick-up from the motor), or pick-up from a power transformer or other magnetic field in the vicinity (try moving phonograph away from suspected source). Check also that the phono input cable shielding is grounded to the amplifier chassis at one point only, through the skirt of the input connector where it plugs into the amplifier. Finally, try a good building ground such as a connection from a cold water pipe terminated under the channel 2, 4Ω impedance tap (ground) on the rear apron of the amplifier. Do not connect such a ground wire to other components in the system. If possible, let each channel be connected to the amplifier using a separate shielded cable to the amplifier input. It is also desirable that the ground leads on both cables not be connected together at any point — not even at the cartridge. However, with some cartridges, it will not be possible to do this. In this case, just disregard this last instruction.

BIAS & BALANCE ADJUSTMENTS

In the ST-70, fixed bias is employed in the output stages. Each of the two amplifiers is provided with a BIAS ADJ. potentiometer and a BALANCE ADJ. potentiometer. It is essential that these controls be adjusted exactly as instructed before putting a completed kit amplifier into use, or at any time thereafter when any of the output tubes are replaced, or it is suspected that a dc unbalance in the output tubes has occurred in the course of use.

In the Final Steps of the Construction section, it is instructed that both BALANCE ADJ. pots R79 and R80, and both BIAS ADJ. pots, R103 and R104, be set to mid-rotation before connecting the unit to the AC line. Be sure this is done. Then connect speakers to the amplifiers exactly as described in speaker connections.

Next, turn the amplifier on and set the LEVEL control down to zero. Immediately after the unit is turned on, perform bias and balance adjustment in each amplifier according to the methods and schedule given below.

Instrument Required: VOM or VTVM of at least ±3% accuracy on DC voltage measurement, with a lowest DC voltage range not exceeding 3 volts full scale.

a) BALANCE ADJUST METHOD. (Use the BALANCE ADJ. pot and METER jacks for the particular amplifier, 1 or 2, being adjusted. See Fig. 3) Set the VOM or VTVM to the lowest DC voltage range and at either

LOUDNESS slide switch: A characteristic of human hearing is that sensitivity to bass tones diminishes more rapidly, as the listening level is lowered, than sensitivity to middle and high frequency tones. Many people find the audible loss of bass at low listening levels unsatisfying. Setting the LOUDNESS slide switch to ON provides a compensating amount of bass boost at low listening levels. Do not leave the LOUDNESS switch at ON when listening at normal volume, since the amount of bass boost provided will usually be excessive and unmusical. Some people prefer not to use loudness compensation at all, because it does not correspond to any natural listening condition at a live performance.

BASS CONTROL CH. 1, BASS CONTROL CH. 2 (CONCENTRIC): The plus sign on the right side of the dial indicates that clockwise rotation from the mid-point (0) of either control increases (boosts) bass response; the minus sign on the left side indicates that counter-clockwise rotation from the mid-point decreases (cuts) bass response. There is no interaction with the TREBLE control. Start all adjustments with this control set at the mid-point (0), which is called the "flat" position since bass response is neither cut nor boosted at this position.

TREBLE CONTROL CH. 1, TREBLE CONTROL CH. 2 (CONCENTRIC): The plus sign on the right side of the dial indicates that clockwise rotation from the mid-point (0) of either control increases (boosts) treble response; the minus sign indicates that counter-clockwise rotation from the mid-point decreases (cuts) treble response. There is no interaction with the BASS control. Start all adjustments with this control set at the mid-point (0), which is called the "flat" position since treble response is neither cut nor boosted at this position.

The amplifier ON-OFF power switch is ganged with the CH. 2 TREBLE control. Note the word "OFF" on the panel just beyond full-counter-clockwise rotation. The plain circle symbol preceeding it indicates that the power switch is ganged with the CH. 2 control. Turn the amplifier off by turning the CH. 2 TREBLE control beyond full counter-clockwise rotation until the power switch clicks to OFF. Turn the amplifier on by turning the CH. 2 TREBLE control clockwise from OFF and setting it at the mid-point (0) or some customary setting of the CH. 2 TREBLE control you may use.

SPEAKER PHASE slide switch: Used to correct for an out-of-phase condition between the left and right channel signals. Has two positions: N (normal) and R (reverse). When the switch is set at R, the polarity of the channel 2 output signal is internally reversed, which will restore the in-phase relationship between the left and right signals regardless of how the out-of-phase condition was caused. However, if the speakers are connected and phased with the SPKR PHASE switch set at N as described in SPEAKER CONNECTIONS, and no auxiliary equipment is normally feeding out-of-phase stereo signals to the amplifier, then the left and right signals should normally be in phase (with the SPKR PHASE switch set at N), unless the stereo recording or broadcast material is accidentally out-of-phase. To determine whether or not stereo signals are in phase, you may use the following criteria. Out-of-phase signals tend to be heard separately from each speaker, rather than forming a distinct stereophonic sound image spread between the speakers. Also, in-phase signals tend to produce stronger bass, whereas out-of-phase signals produce thinner bass.

LO FILTER slide switch: Set to ON when it is desired to cut low frequency response below 100 cps because of rumble in a phonograph or even in broadcast program material. Phonograph rumble is usually at about 29 cps and may well not be directly audible. Sometimes it can be at a much lower frequency, which is definitely not directly audible. However, the effect of rumble can be heard even the rumble itself is not. It manifests itself by using up amplifier power at low frequencies and can even overload the amplifier. If, at normal listening levels on phonograph, setting the LO FILTER to ON definitely results in "cleaner", less-distorted sound, the indication is that your phonograph suffers from excessive rumble. Whether it is worth doing anything about it, depends on the installation. If you have inexpensive speaker systems that do not produce substantial undistorted sound below 80 cycles, you may just as well live with the rumble and eliminate its bad effects by using the LO FILTER. If you have made a considerable investment in speakers, partly in order to obtain full, undistorted response below 80 cycles, you may not want to forego full bass response. In the latter cases, have the phonograph examined by a qualified service man to see if the rumble is caused by a defect that can be remedied.

HI FILTER slide switch: Set to ON when it is desired to cut high frequency response above 5000 cps. Useful for minimizing extraneous noise when listening to narrow range AM broadcasting, for listening to noisy or worn records, and for reducing the annoyance of excessive distortion from any source.

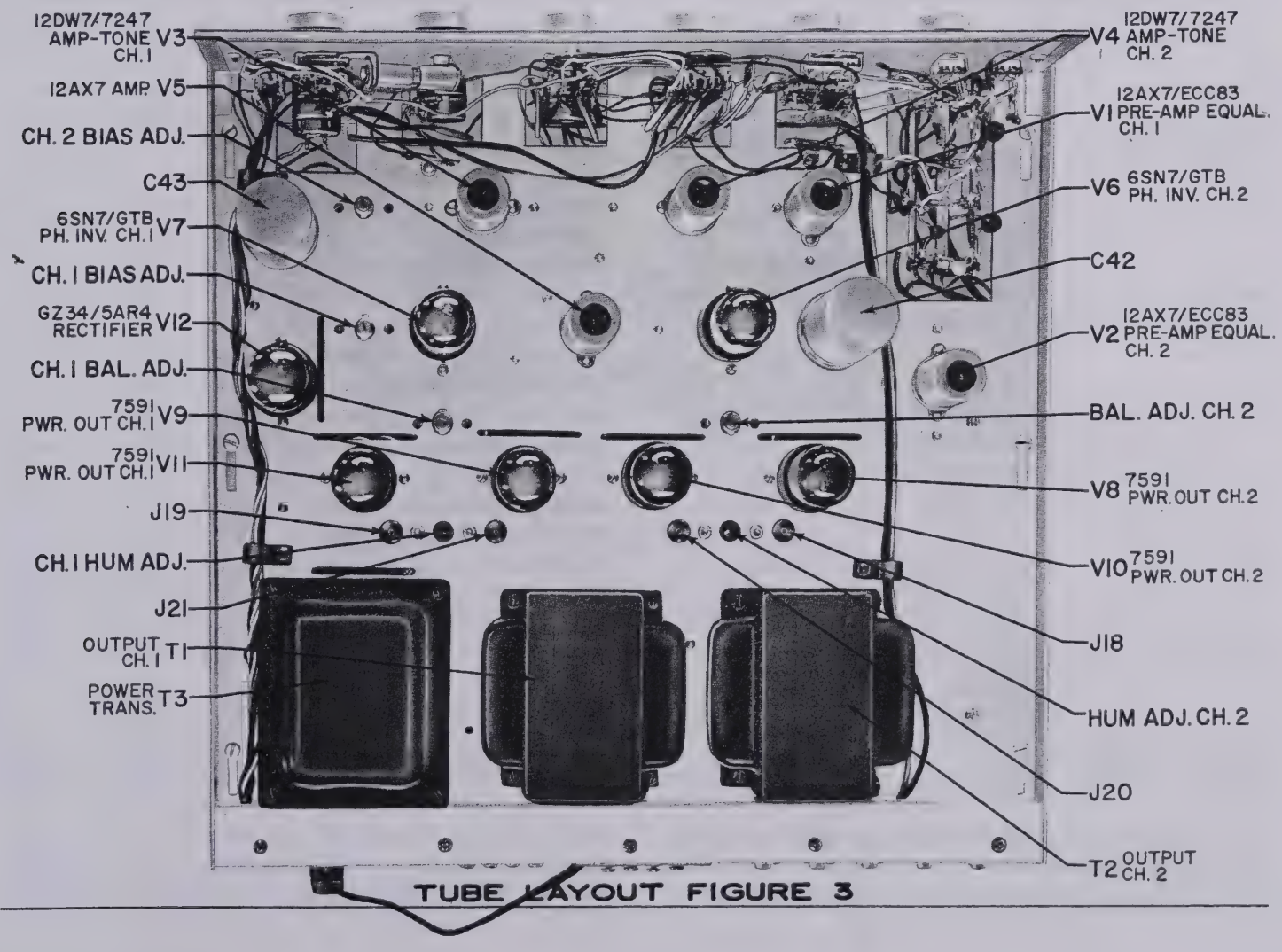
the VOLTAGE and RESISTANCE chart and check the troublesome amplifier, or both amplifiers, by the procedures given. Study the chart and the accompanying notes thoroughly before you begin. The 1kc signal required may be obtained from an audio generator and a 100:1 attenuator (for best signal-to-noise ratio).

TRANSFORMER TEMPERATURE

The transformers used in this unit run at a temperature less than 195°F despite the fact that the safety limit is at a much higher 221°F. Although 195°F is cool for a transformer, it is very hot to the touch. Transformers which seem too hot when touched are usually good and Output transformers usually run cooler than power transformers. Some output transformers may appear hotter than others due to being located near hot components such as output and power tubes and power transformers.

SERVICE

If trouble develops in your instrument which you can not remedy yourself, write to our service department listing all possible indications that might be helpful. List, also, any code numbers in red under the words INSTRUCTION MANUAL on the cover. If desired, you may return the instrument to our factory where it will be placed in operating condition for $13.50 plus the cost of parts replaced due to their being damaged in the course of construction. NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the instrument, giving your home address and the trouble with the unit. Pack very carefully in a rugged container, using sufficient packing material (cotton, shredded newspaper, or excelsior), to make the unit completely immovable within the container. The original shipping carton is satisfactory, providing the original inserts are used or sufficient packing material inserted to keep the instrument immovable. Ship by prepaid Railway Express, if possible, to Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, New York. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damages in transit if packing IN HIS OPINION, is insufficient.



TUBE LAYOUT FIGURE 3

the plus or minus DC voltage function. Connect the meter leads to the pair of METER pin jacks for amplifier 1 or amplifier 2 on the chassis. If the meter deflects to the left of zero, switch the function to the opposite sign or reverse the leads. Adjust the corresponding BALANCE ADJ. control for a zero or minimum reading. This completes the balance adjustment, whereupon the meter leads can be removed from the meter pin jacks.

b) BIAS ADJUST METHOD. (Use the BIAS ADJ. pot and a METER jack of the pair for the particular amplifier, 1 or 2, being adjusted.) Set the VOM or VTVM at the plug DC voltage function and the lowest DC voltage range (not exceeding 3 volts full scale). Insert the "hot" meter lead into either one of the pair of METER pin jacks for the particular amplifier (1 or 2) being adjusted, and connect the common or ground meter lead to a convenient chassis ground point. Set the corresponding BIAS ADJ. control for a meter reading of 0.38 volt. This completes the bias adjustment, whereupon the meter leads can be removed.

NOTE:	CH. 1	CH. 2
METER JACKS	J19 & J21	J18 & J20
BALANCE ADJ. control	R79	R80
BIAS ADJ. control	R103	R104

BALANCE & BIAS ADJUSTMENT SCHEDULE

Immediately upon turning amplifier on for the first time (either after completing the kit or after replacing output tubes):

1. Adjust BALANCE amplifier 1
2. Adjust BIAS amplifier 1
3. Adjust BALANCE amplifier 2
4. Adjust BIAS amplifier 2

Repeat steps 1, 2, 3 and 4

15 minutes later - Repeat steps 1, 2, 3 and 4

2 hours later - Repeat steps 1, 2, 3 and 4

2 weeks later - Repeat steps 1, 2, 3 and 4

SERVICING

Your amplifier should require little service except for normal tube replacement. We recommend no substitutions for the tube types used in this amplifier except as stated. All the tube types used are distributed nationally, but replacements can be obtained directly from EICO if desired.

To facilitate servicing, remedial and trouble-shooting procedures have been provided in the TROUBLE-SHOOTING CHART that follows. A VOLTAGE AND RESISTANCE CHART is also provided as an aid in locating defective components. DC operating voltages are given both at no signal and signals developing 30 watts output, as well as the corresponding 1kc signal voltages.

TROUBLE SHOOTING PROCEDURES

Connect a stereo phono and a pair of speakers to the amplifier as described in INPUT CONNECTIONS and OUTPUT CONNECTIONS. Do not operate the amplifier without speakers or equivalent loads connected exactly as described. Set the SELECTOR switch to the corresponding phono position (PH. A or PH. B) and the MODE switch to STEREO. Play a known high quality stereo recording on the phonograph. If there is no output to the speaker, or if the output is low or audibly distorted, proceed to the checks for those symptoms. If there is excessive hum in the output, disconnect the phono input cable from the amplifier and short the phono input jack to chassis. If the hum disappears, the trouble is not in the amplifier but in the phonograph or in the connection to the amplifier. In each case, check for the trouble in the amplifier which seems defective. If both amplifiers are defective, check the power supply.

Excessive hum on other inputs may be checked in a similar manner. Disconnect the input cable in question and short the particular input jack to the chassis. If the hum disappears, the trouble is external to the amplifier. Note that on all inputs, the braid of the input cable should connect to the amplifier only through the skirt of the input connector. The cause and remedies for the symptoms listed in the TROUBLE-SHOOTING CHART are then based on the assumption that checks made in the manner described above have eliminated the possibility of the trouble being external to the amplifier.

If the trouble is no output, low output, or distorted output, in either or both amplifiers, check for a tube that does not warm up (replace), or test the tubes (one at a time) on a tube tester or by substitution. Do not turn the amplifier on with the 7591 output tubes removed. If the tubes appear to be good, proceed to

REPLACEMENT PARTS LIST

SYM.#	STOCK#	AM'T.	DESCRIPTION	STOCK#	AM'T.	DESCRIPTION
C1, 2	22538	2	capacitor, disc, 400mmf, 10%	40000	51	nut, hex, #6-32
C3, 4	22520	2	capacitor, disc, .0012mfd (1.2K or 1200mmf), 10%	40001	6	nut, hex, 3/8-32
C5, 6	22522	2	capacitor, disc, 330mmf, 10%	40007	50	nut, hex, #4-40
C7, 8, 9, 10	22517	4	capacitor, disc, .025mfd, GMV	40008	12	nut, hex, #8-32
C11, 12	22534	2	capacitor, disc, 68mmf, 10%	40016	1	nut, 1/2" fuseholder
C13, 14	22580	2	capacitor, disc, .2mfd, +80%, -20%	41035	5	screw, #6 x 1/4, self tapping
C15, 16, 17,	20039	8	capacitor, molded, .1mfd, 400V	41047	7	screw, #8, self tapping
18, 19, 20,				41086	51	screw, #6-32 x 5/16
21, 22				41090	34	screw, #4-40 x 5/16
C23, 24	22547	2	capacitor, disc, .015mfd (15K or 15,000mmf), 20%	41091	16	screw, #4-40 x 1/4, flat head
C25, 26	22511	2	capacitor, disc, .005mfd (5K or 5000mmf), 20%	41026	2	screw, #4-40 x 1/4, brass
C27, 28	22523	2	capacitor, disc, .0068mfd (6.8K or 6800mmf), 10%	41097	2	screw, #6-32 x 5/16, brown oxide
C29, 30	22548	2	capacitor, disc, .009mfd (9K or 9000mmf), 10%	41099	18	screw, #8-32 x 3/8, Type F, brown oxide
C31, 32	22547	2	capacitor, disc, .015mfd (15K or 15,000mmf), 20%	41100	2	screw, #8-32 x 1 3/4
C33, 34	23020	2	capacitor, elec., 25mfd, 6V	42000	6	washer, lock, 3/8
C35, 36	22545	2	capacitor, disc, 125mmf, 10%	42002	50	washer, lock, #6
C37, 38	20044	2	capacitor, molded, .25mfd, 400V	42007	50	washer, lock, #4
C39, 40	23011	2	capacitor, elec., 50mfd, 50V	42005	2	washer, #6, flat
C41	23015	1	capacitor, elec., 50mfd, 150V	42008	12	washer, lock #8
C42	24012	1	capacitor, elec., 40/20/20/20mfd, 450V	42029	1	washer, rubber, 1/2" for fuseholder
C43	24008	1	capacitor, elec., 40/20mfd, 500V	42032	2	washer, flat #8, 7/16" OD
C44	23041	1	capacitor, elec., 30mfd, 400V	43000	2	lug, ground, #6
C45	23003	1	capacitor, elec., 16mfd, 350V	43004	4	lug, ground, #8
C46	23001	1	capacitor, elec., 10mfd, 25V	46000	1	grommet, rubber, 3/8
C47	20043	1	capacitor, molded, .03mfd, 600V	46011	4	plastic feet
CR1	93005	1	rectifier, 200ma/380 PIV	50019	5	insulator for 50018
F1	91005	1	fuse, 3Amp	53047	2	knob, concentric, inner
I1	92000	1	bulb, #47	53048	2	knob, concentric, outer
J1, 2, 3; 4, 5,	50018	5	jack, phono, triple	53049	4	knob, dual, split knurl
6; 7, 8, 9; 10,				57003	1	line cord
11, 12; 13,				58004	length	wire, hook-up, black
14, 15				58005	length	wire, hook-up, brown
J16, 17	50009	2	A.C. receptacle	58006	length	wire, hook-up, red
J18, 19, 20, 21	50007	4	jack, pin	58007	length	wire, hook-up, orange
PC1, 2	29751	2	printed circuit	58008	length	wire, hook-up, yellow
R1, 2	10428	2	resistor, 47K, 1/2W, 10% (yellow, violet, orange, silver)	58009	length	wire, hook-up, green
R3, 4	10410	2	resistor, 100K, 1/2W, 10% (brown, black, yellow, silver)	58010	length	wire, hook-up, blue
R5, 6, 7, 8	11526	4	resistor, 200K, 1/2W, 5% (red, black, yellow, gold) ✓	58011	length	wire, hook-up, violet
R9, 10	11532	2	resistor, 4M, 1/2W, 5%, (yellow, black, green, gold)	58012	length	wire, hook-up, grey
R11, 12	10407	2	resistor, 1M, 1/2W, 10% (brown, black, green, silver)	58013	length	wire, hook-up, white
R13, 14	10424	2	resistor, 22K, 1/2W, 10% (red, red, orange, silver)	58300	length	spaghetti, small
R15, 16	11512	2	resistor, 2.4K, 1/2W, 5% (red, yellow, red, gold) ✓	58303	length	spaghetti, large
R17, 18	10455	2	resistor, 1.5M, 1/2W, 10% (brown, green, green, silver)	58408	length	cable, 1 conductor black
R19, 20	11520	2	resistor, 40K, 1/2W, 5% (yellow, black, orange, gold) NC	58412	length	cable, 3 conductor
R21, 22	11533	2	resistor, 1.2K, 1/2W, 5% (brown, red, red, gold) ✓	58414	length	cable, 1 conductor grey
R23, 24	10435	2	resistor, 150K, 1/2W, 10% (brown, green, yellow, silver)	58501	length	wire, bare
R25, 26	10408	2	resistor, 680K, 1/2W, 10% (blue, grey, yellow, silver)	80091	1	panel
R27, 28	11523	2	resistor, 68K, 1/2W, 5% (blue, grey, orange, gold) ✓	81175	2	cable clamp, plastic
R29, 30	10421	2	resistor, 6.8K, 1/2W, 10% (blue, grey, red, silver)	81269	1	chassis
R31-32	18068	1	pot., 750K, dual	81270	1	rear panel
R33-34	18069	1	pot., 250K, dual	81271	1	bottom plate
R35, 36	10413	2	resistor, 2.7K, 1/2W, 10% (red, violet, red, silver)	81272	1	hood
R37, 38, 39, 40	11546	4	resistor, 33K, 1/2W, 5% (orange, orange, orange, gold)	81920	6	cable clamp
R41, 42	10417	2	resistor, 220K, 1/2W, 10% (red, red, yellow, silver)	81924	1	bracket, extrusion, left side rail
R43, 44	10442	2	resistor, 1.5K, 1/2W, 10% (brown, green, red, silver)	81925	1	bracket, extrusion, right side rail
R45-46	18071	1	pot., 1M, concentric	89537	1	pilot light shield
R47-48-S10	18070	1	pot., 50K, concentric, with SPST switch	97300	5	shield for 9 pin socket
R49, 50, 51, 52	10431	4	resistor, 470K, 1/2W, 10% (yellow, violet, yellow, silver)	97717	1	jewel for pilot light
R53, 54	11526	2	resistor, 200K, 1/2W, 5% (red, black, yellow, gold) ✓	66349	1	manual of instruction (kit)
R55, 56	10432	2	resistor, 1K, 1/2W, 10% (brown, black, red, silver)	66096	1	manual of instruction (wired)
R57, 58	11505	2	resistor, 100Ω, 1/2W, 5% (brown, black, brown, gold) ✓	89627	1	glue capsule

TROUBLE-SHOOTING CHART

SYMPTOM	CAUSE	REMEDY
Amplifier causes power line fuse to blow. Power line fuse blows again with V12 out of its socket.	Line cord, J16, J17, primary or high voltage secondary windings of T3 shorted internally or externally (wiring).	Replace or repair.
Amplifier causes power line fuse to blow. Power line fuse does not blow again with V12 out of its socket.	Defective V12, C43, V8, V9, V10, V11; T1 or T2 primary shorted internally or externally.	Replace or repair.
Any or half of tube filaments not lit.	Open tube filament. Open lead from one of the 6.3V windings of T3. One 6.3V winding of T3 open.	Replace or repair.
DC voltage at V12, cathode (pin 8) is incorrect as specified below.		
a) No voltage.	Defective V12. C43 shorted internally or externally.	Replace Replace or repair.
b) High voltage.	Connection to center tap of h.v. secondary winding of T3 open. Output tubes, V8, V9, V10, V11 over-biased or not drawing current.	Check possible causes and replace or repair. Check possible causes and repair. Readjust bias and DC balance controls.
c) Low voltage.	Excessive current drain in amplifier. Defective V12	Adjust bias and DC balance controls. Replace
Excessive hum on mag. phono tape head or mic.	V1 or V2 defective. Filament leads dressed too close to grid lead. Tube shield not making electrical contact to base or base not making electrical contact to chassis. Shielding and grounding of wiring to input jacks not exactly as instructed and shown in drawings.	Replace Dress filament leads away from grid lead. Check and correct. Correct
Excessive noise on mag. phono or tape head.	V1 and V2 and contacts dirty. Poor solder-flux connection	Clean thoroughly with carbon tetrachloride. Resolder
Sustained oscillations.	Poor dress of output transformer T1 or T2 leads.	Dress all input leads and T1, T2 leads away from each other. Keep T1, T2 leads away from input jacks.
Sustained microphonics on mag. phono, tape head or mic.	V1 or V2 defective.	Replace
Hum on all inputs	V3 or V4 defective, not properly shielded, or dirty sockets and contacts. Dress of power transformer T3 leads.	Replace, correct, or clean. Correct.

VOLTAGE AND RESISTANCE CHART

	Pin#	Column 1 DC volts at 30 watts ea. channel	Column 2 DC volts at no signal	Column 3 AC volts (signal) at 35 watts one channel at a time	Column 4 Resistance in ohms Pin 8 of XV12 grounded
V1, 2	1	182	200	.48	60K
	2	0	0	.032	1.5Meg
	3	1.25	1.38	.018	1200
	4	12.5	13.8		100K
	5	12.5	13.8		100K
	6	75	80	.032	325K
	7	0	0	.0041	1.2M
	8	0.7	0.75	.0037	2400
	9	12.5	13.8		100K
V3, 4	1	95	105	.28	62K
	2	0	0	.05	250K
	3	3.4	3.7	.023	1500
	4	12.5	13.8		100K
	5	12.5	13.8		100K
	6	138	150	.24	62K
	7	0	0	.022	280K
	8	.85	.95	.0125	1K
	9	12.5	13.8		100K
V5	1	77	97	2.6***	320K
	2	0	0	.24***	240K
	3	.55	.70	.2***	1100
	4	12.5	13.8		100K
	5	12.5	13.8		100K
	6	77	97	0***	320K
	7	0	0	0***	240K
	8	.55	.70	0***	1100
	9	12.5	13.8		100K
V6, 7	1	77	97	2.6	320K
	2	234	300	18	33K
	3	80	100	1.24	18K
	4	234	300	<.001	1.3M
	5	80	100	18	37K
	6	80	100	1.24	18K
	7	12.5	13.8		100K
	8	12.5	13.8		100K
V8, 9 V10, 11	1	-18	-19	18	190K
	2	12.5	13.8		100K
	3	400	450	270	80-110
	4	320	400	.25	1800
	5	.7	.38	1	10
	6	-18	-19	18	195K
	7	12.5	13.8		100K
	8	320	400	.25	1800
V12	1				
	2	405	455		>30K**
	3				
	4	360*	360*		15-25
	5				
	6	360*	360*		15-25
	7				
	8	405	455		30K**

Column 1:

Both amplifiers are fed a 1kc signal through a high level input to produce 30 watts output from each amplifier. A dummy load must be connected to each amplifier output. Feed a 1kc signal to the TAPE 1 input and set the SELECTOR switch to TAPE/AUX. Set the MODE switch to MONO 1, the BASS and TREBLE controls for both channels to zero and all slide switches to the down position. Then set the audio generator output, and the LEVEL and BALANCE controls, to obtain the appropriate 1kc signal voltage corresponding to 30 watts output (from the table) across the speaker output terminals of each channel to which the dummy loads are connected. If a defect in either or both amplifiers makes it impossible to obtain the required signal voltage across the speaker output terminals, feed a 480mv, 1kc signal to the TAPE 1 input and proceed to the measurements.

Column 2:

Same as for Column 1 but remove input signal.

Column 3:

One channel amplifier at a time is fed a 1kc signal through the appropriate PH. A input to produce 35 watts output. A dummy load must be connected to each amplifier output. To check the channel 1 amplifier, feed a 1kc signal to the PH. A1 input, and set the MODE switch to ✓CH. 1. Set the SELECTOR switch to PHONO A, the BALANCE control to zero, the BASS and TREBLE controls for both channels to zero, and all slide switches to the down position. Then set the audio generator output and the LEVEL control to obtain the appropriate 1kc signal voltage corresponding to 35 watts output and the LEVEL control to obtain the appropriate 1kc signal voltage corresponding to 35 watts output (from the table) across the CH. 1 speaker output terminals to which the dummy load is connected. To check the channel 2 amplifier, feed a 1kc signal to the PH. A2 input, and set the MODE switch to ✓ CH. 2. All other controls remain set as before. Then set the audio generator output and the LEVEL control to obtain the appropriate 1kc signal voltage corresponding to 35 watts output (from the table) across the CH. 2 speaker output terminals to which the dummy load is connected. Note that the entries for V5, as given are for the channel 1 amplifier test. In checking the channel 2 amplifier, pins 6, 7 and 8 of V5 should give the readings entered above for pins 1, 2 and 3, respectively, whereas pins 1, 2 and 3 should read zero. If a defect in either amplifier makes it impossible to obtain the required signal voltage across the speaker output terminals, feed a 4mv, 1kc signal to the PH. A input for that amplifier and proceed to the measurements.

Column 4:

Set controls as in Column 1. Disconnect unit from AC line and remove all input and output connections. Short pin 8 of XV12 (rectifier) to chassis ground with a jumper throughout resistance measurements, except when pins 2 and 8 of XV12 are being checked.

*AC 60 cycles

**Short from pin 8 of XV12 to ground removed.

***Correct as given, only for the Channel 1 amplifier test.. In checking the channel 2 amplifier, pins 6, 7 and 8 of V5 should give the readings entered for pins 1, 2, and 3, respectively, whereas pins 1, 2 and 3 should read zero.

TABLE OF AC VOLTAGES ACROSS SPEAKER OUTPUT TERMINALS CORRESPONDING TO 30 & 35 WATTS OUTPUT FOR VARIOUS STANDARD DUMMY LOADS

Load R (Ω)	V_{AC} for $P_{OUT} = \frac{V_{AC}^2}{R} = 30W$	V_{AC} for $P_{OUT} = \frac{V_{AC}^2}{R} = 35W$
16	21.9	23.6
8	15.5	16.7
4	10.9	11.8

REPLACEMENT PARTS LIST (CONTINUED)

SYM.#	STOCK#	AM'T.	DESCRIPTION
R59, 60	10407	2	resistor, 1M, 1/2W, 10% (brown, black, green, silver)
R61, 62	11601	2	resistor, 28.75K, 1W, 5%
R63, 64	11602	2	resistor, 33K, 1W, 5% (orange, orange, orange, gold)
R65, 66	11600	2	resistor, 18K, 1W, 5% (brown, grey, orange, gold)
R67, 68, 69, 70	10435	4	resistor, 150K, 1/2W, 10% (brown, green, yellow, silver)
R71, 72, 73, 74	10430	4	resistor, 4.7K, 1/2W, 10% (yellow, violet, red, silver)
R75, 76, 77, 78	11527	4	resistor, 100K, 1/2W, 5% (brown, black, yellow, gold)
R79, 80	18029	2	pot., 50K, snap-in
R81, 82, 83, 84	11703	4	resistor, 10Ω, 1W, 1%
R85, 86	11557	2	resistor, 6K, 1/2W, 5% (blue, black, red, gold)
R87, 88	10432	2	resistor, 1K, 1/2W, 10% (brown, black, red, silver)
R89	11558	1	resistor, 5.3K, 1/2W, 5% (green, orange, red, gold)
R90	14850	1	resistor, 16Ω, 20W, 5%, W.W.
R91, 92, 93	10956	3	resistor, 10K, 2W, 10% (brown, black, orange, silver)
R94, 95	10444	2	resistor, 120K, 1/2W, 10% (brown, red, yellow, silver)
R96	14502	1	resistor, 1800Ω, 5W, 10%, W.W.
R97	10950	1	resistor, 2200Ω, 2W, 10% (red, red, red, silver)
R98, 99	10422	2	resistor, 68K, 1/2W, 10% (blue, grey, orange, silver)
R100, 101	10426	2	resistor, 33K, 1/2W, 10% (orange, orange, orange, silver)
R102, 103	18029	2	pot., 50K, snap-in
R104	10407	1	resistor, 1M, 1/2W, 10% (brown, black, green, silver)
R105	10410	1	resistor, 100K, 1/2W, 10% (brown, black, yellow, silver)
R106, 107	19016	2	pot., 100Ω, W.W.
S1	60074	1	switch, rotary, 4 section
S2	60083	1	switch, rotary, 1 section
S3, 4	62012	2	switch, slide, DPDT
S5, 6, 7, 8	62014	4	switch, slide, 4PDT
S9	62012	1	switch, slide, DPDT
S10		1	switch, SPST mounted on R47-48
T1, 2	32021	2	transformer, output
T3	30048	1	transformer, power
TB1, 2, 3	54500	3	terminal board, 4 screw
TB4	54002	1	terminal strip, 1 post right with ground
TB5, 6, 7, 8, 9, 10, 11, 12, 13	54003	10	terminal strip, 2 post
TB14, 15, 16	54006	3	terminal strip, 3 post 2 right
TB17, 18, 19	54001	3	terminal strip, 1 post right
TB20, 21	54000	2	terminal strip, 1 post left
TB22	54019	1	terminal strip, 2 post right
TB23	54015	1	terminal strip, 3 post 2 left with ground
TB24	54023	1	terminal strip, 2 post left with ground
TB25	54008	1	terminal strip, 4 post
TB26	54014	1	terminal strip, 3 post 2 left
TB27	54003	1	terminal strip, 2 post
V1, 2	90034	2	tube, 12AX7/ECC83/7025
V3, 4	90061	2	tube, 12DW7/7247
V5	90034	1	tube, 12AX7/ECC83/7025
V6, 7	90041	2	tube, 6SN7GTB
V8, 9, 10, 11	90073	4	tube, 7591
V12	90044	1	tube, GZ-34
XI1	97712	1	pilot light assembly
XF1	97800	1	fuseholder
XV1, 2, 3, 4, 5	97027	5	socket, 9 pin min. with shield support
XV6, 7, 8, 9, 10, 11, 12	97032	7	socket, octal

The reference designation assigned to receptacles (often referred to as jacks) is the letter J. The different types of jacks and plugs used in this kit are so lettered and illustrated here as well as in the construction steps. In some cases, three jacks are mounted on one bakelite strip and are so noted.

TRIPLE PHONO JACK

AC RECEPTACLE

In some cases, these jacks are insulated from the chassis. A bakelite insulator used between the chassis and the jack is supplied for this purpose.

The reference designation assigned to capacitors is C.

Some capacitors, such as electrolytics, are marked plus (+) and minus (-). These are the only capacitors that must be mounted in a specific direction. Follow the direction for mounting described in the appropriate steps below. When no direction is mentioned, mount the capacitor either way. Some molded paper capacitors have a black line near one end. Although these can be mounted without any concern for direction, it is preferable that you follow the direction for the black line shown on the drawing. If there is no black line on the drawing or on the capacitor, just mount the capacitor in either direction.

The peak or working voltages are important capacitor characteristics. A capacitor marked with a higher voltage may be substituted for a lower voltage unit. Thus, a 1000 volt capacitor may be used in place of a 500 volt unit. The reverse is obviously not true. You cannot use a 500 volt unit as a substitute for a 1000 volt capacitor. Where more than one capacitor of identical value but different breakdown voltages are used, the unit you are to use is indicated in the appropriate construction step.

Ceramic capacitor tolerance may be noted by a letter rather than a number. "K" is 10%. "M" is 20%, "P" or "GMV" means guaranteed minimum value.

Ceramic capacitors have specific temperature characteristics — percent and degree of variation of capacity with temperature. These variations are indicated by means of a code number stamped on most capacitors. Thus, a capacitor marked 68 Z5E indicates a 68mmf capacitor having a Z5E temperature characteristic. The actual meaning of Z5E, or any other characteristic, is important to the engineer. When building the kit, be sure to use the capacitor with the characteristic specified by the engineer, if it is indicated in the construction steps. If no value is indicated in the construction book, use any of the ceramic capacitors of proper value, tolerance and voltage characteristics, supplied with the kit.

Resistors are denoted by the symbol letter R.

Some resistors have their resistance value stamped on the surface of the resistor body. However, other fixed resistors are coded with color bands which indicate their value. The actual color code of these resistors is noted in the parts list. In some instances, even when the color code is noted, in the book, the actual resistor value may be stamped on the body, rather than the color code.

The tolerance of a resistor is the amount the resistance can vary around its marked value. Thus, if a 1KΩ (1000 ohms) resistor has a ±10% tolerance, its actual value can be between 900 ohms and 1100 ohms. If the same resistor has a ±5% tolerance, its actual value is always stated or given as part of the color code when the resistor is listed. If the resistor is marked with a number rather than a color code, the tolerance, is stamped on the body. In your kit, 5% resistors may be substituted for 10% and 10% resistors substituted for 20%. However, be certain that you do not use a 10% resistor when a 5% resistor is required or a 20% resistor when a 10% or 5% resistor is specified.

Resistors are capable of dissipating power. Large resistor handle more power while smaller ones handle less. A 1/2 watt resistor is usually smaller than a 1 watt unit, while a 1 watt resistor is usually smaller than a 2 watt unit. If like valued resistors are used in the kit, differing in power rating, the proper resistor to use is designated in the particular construction step.

Besides the fixed resistors discussed, there are also variable resistors known as potentiometers. They may be equipped with shafts on which a control knob may be mounted. The potentiometer combinations R31-R32 and R33-R34, are both dual pots controlled by one shaft. R45-R46 and R57-R48 are dual pots each controlled by their individual concentric shafts. In addition, the power switch, S10, is mounted on the rear of potentiometer R48 and is activated by the same shaft (inner concentric), which varies the resistance of R48.

Other variable resistors may each have a short shaft with a slotted end or simply a slot in the variable element, requiring a small screwdriver for adjustment. This latter types are generally used for infrequently made adjustment, such as for the hum controls in the ST-70.

CONSTRUCTION BOOK

The EICO kit you are about to assemble and wire has been designed to meet the highest standards of performance. It is a high quality amplifier to be constructed from the finest components available anywhere.

The following Construction Manual has been written to carefully guide you through the construction of your kit. If you follow all the instructions implicitly and work carefully without haste, you will be rewarded with many years of fine performance from this amplifier and a personal inner satisfaction from a job well done.

Your Construction Book: Beginning with the number on this page, and throughout the rest of your Construction Manual, the page numbers are followed by a "C" (1C, 2C, etc.). The Instruction Manual, detailing the installation, operation and maintenance of your amplifier, are identified by numerals only, without any letters following these numerals.

Observe that the Instruction Manual section precedes this page and follows the last page of your Construction Book section. After you are certain that you have successfully completed the wiring of your kit, you no longer need the Construction Book. You may remove these centrally located Construction pages, leaving the Instruction section intact for future reference. Keep the Instruction Manual for information as to the installation and operation, as well as for any maintenance that may be necessary in the future, on your amplifier.

Choosing a Workbench and Tools: To avoid the accidental loss or misplacement of components, choose a convenient workbench before unpacking your new kit. You will find it most advantageous to choose a corner on a table that will not be used for any other purpose until you have completed the construction of your kit. Proper precautions should be observed to prevent damage to any table top from a soldering iron or any heavy tools.

When you check the component parts against the Parts List later on, it will be convenient to separate the various pieces into types of components and hardware sizes. It will be convenient to keep these sorted pieces separated in the compartments of specially made trays. Small cartons, egg trays or a refrigerator ice tray with dividers serve equally well.

Several basic tools are required to constructing this kit. They are:

1. Screwdriver - 3/16" to 1/4" blade
2. Screwdriver - 1/8" blade
3. Long nose pliers - 5" or 6"
4. Diagonal wire cutters
5. Soldering iron (100 watts), solder gun or pencil iron (35 watts).
6. Gas Pliers
7. High quality rosin core radio solder. DO NOT use Acid Core solder or Paste fluxes under any circumstances.

The following tools are useful, but are not absolutely necessary to construct this kit:

1. Socket wrench set
2. Open end wrench set
3. Wire stripper

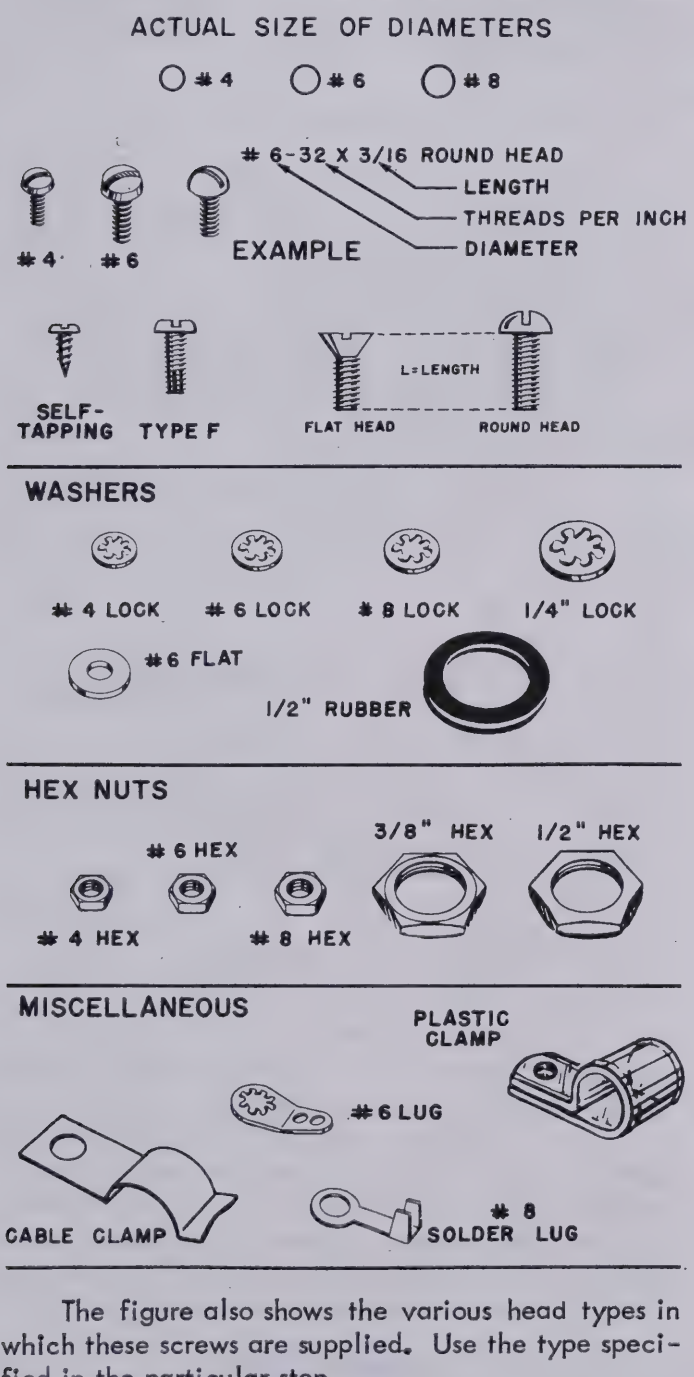
Unpacking the kit: This procedure serves two purposes. First it permits you to become acquainted with the various types of components. Secondly, it enables you to ascertain if you received all the parts required to build the kit. This is your opportunity to have any packing errors corrected.

When unpacking, handle all parts carefully so that you will not damage any fragile components. Do not throw any packing material away until after having checked all components. Check each part off against the "Parts List" which you will find in your Instruction Book. Check the packing for any small parts.

From time to time, due to modernization or possible error, corrections may be necessary to your Parts List. If there are any changes to be made, they will be listed on the loose addenda sheets included with this book. Make the corrections if any, before checking your components. If no corrections of your Parts List are noted on the addenda sheets, or there are no addenda sheets, assume your Parts List is correct, and commence to check all components against this list.

To enable rapid identification of electronic parts, each part has been assigned one or two letters of the alphabet called a "reference designation". These "reference designations" are nothing more than an initial letter or two representing the name of the part. For example, a vacuum tube has been assigned the reference designation letter V, and a transformer the letter T. Thus, if you have eleven vacuum tubes and three transformers in your kit, these parts would be identified by the designation V1 through V12 and T1 through T3, respectively.

usually screws, nuts and washers. Machine screws are sized in accordance with the diameters of the threaded portion (#4, #6, #8) with the smaller number denoting the smaller diameter. The second number indicates the number of threads to an inch. Thus, a #6-32 screw has a #6 diameter with 32 threads per inch. The final number indicates the length of the threaded portion. A #6-32 x 3/8 has a 3/8" long threaded portion. The diameters are shown in the figure.



The figure also shows the various head types in which these screws are supplied. Use the type specified in the particular step.

Washers and nuts are sized in accordance with the diameter of the screws they are used with.

Various types of washers are supplied. A lockwasher may have internal or external teeth. A flat washer is made out of flat metal. Fiber and bakelite washers are used for insulating devices. They generally separate two metallic pieces of hardware. Tinnerman speed nuts are generally used to mount a chassis cover or bottom plate.

Self tapping screws are used where it is not desirable to hold the screw to the chassis by a nut. The screw actually taps the threads in the metal into which it is screwed. The sizes are designated by numbers similar to those used for machine screws, with the smaller number indicating a smaller diameter screw.

Grommets are rubber devices used for insulating wire from the metal chassis.

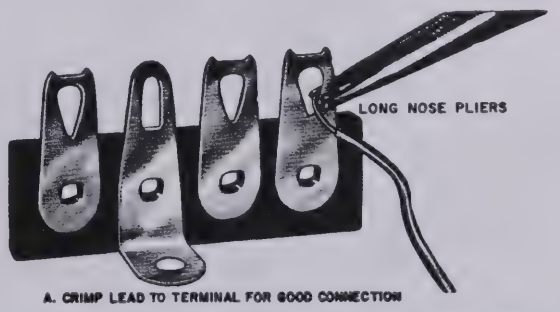
Most of the other component parts used with the kit are self evident and require little further explanation or description.

If after having checked all your components against the parts list, you find a shortage, please write us at:

Customer Service
Electronic Instrument Co., Inc.
33-00 Northern Blvd.
Long Island City 1, N.Y.

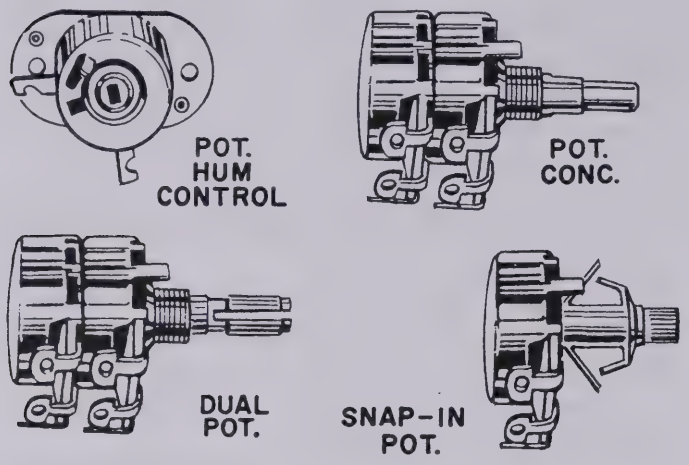
Include the inspection slip, with your letter, describing the shortage. If there is a slight hardware shortage, you can expedite matters by purchasing these pieces at your local jobber or hardware store.

Soldering Techniques: To get a good, clean connection, use the soldering techniques described below. USE THE BEST GRADE OF ROSIN CORE RADIO SOLDER ONLY. UNDER NO CIRCUMSTANCES SHOULD ACID CORE SOLDER OR ACID FLUX BE USED. The use of acid core solder or acid fluxes can cause serious corrosion and will void all the repair and service guarantees.



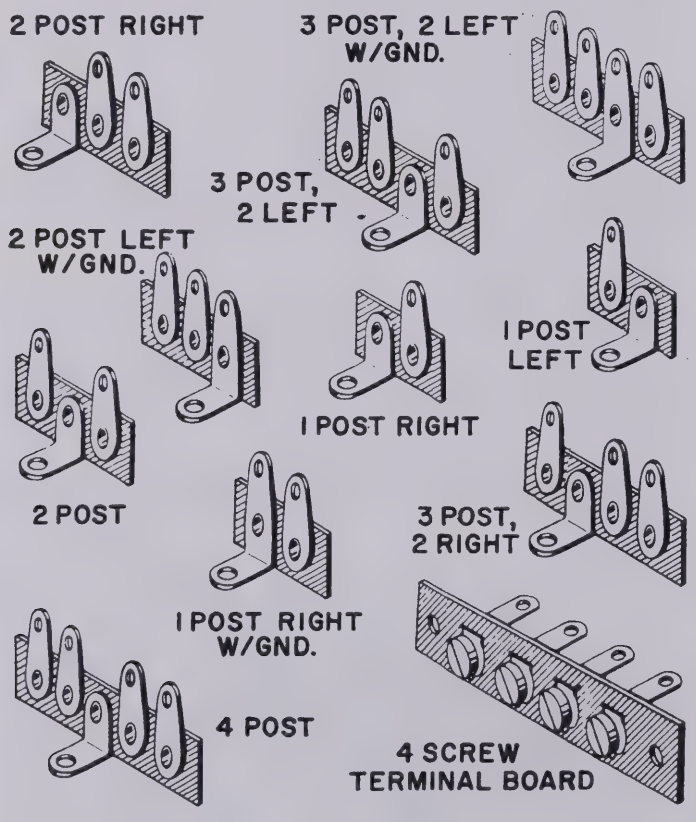
A. CRIMP LEAD TO TERMINAL FOR GOOD CONNECTION

The soldering and wiring techniques described below should be practiced several times by the novice before he attempts to wire or solder components in the actual kit. Practice several connections with a spare piece of wire and a socket or terminal strip that can be purchased at your local jobber.

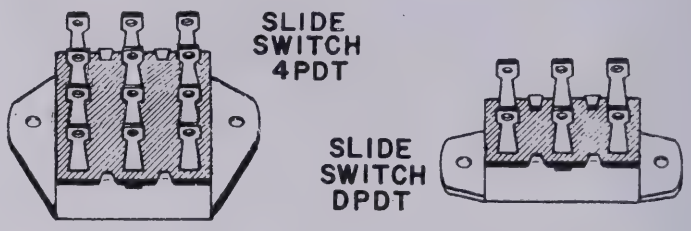


TERMINAL STRIPS

The various types of terminal strips are assigned the designation letters TB. The types used in this kit are illustrated and denoted in this figure.



Switches are designated by the letter S. S1 refers to the switch assigned number 1, S2 refers to the switch assigned number 2. Switches may take several forms. In the ST-70 the rotary switches have been assigned numbers S1 and S2, the slide switches have been assigned numbers S3, S4, S5, S6, S7, S8 and S9. The power on-off switch mounted on the rear of the treble control potentiometer R47 and R48, has been assigned number S10. Each lug on the slide switches has been assigned a number. Thus S5-3 refers to lug #3 on slide switch S5.

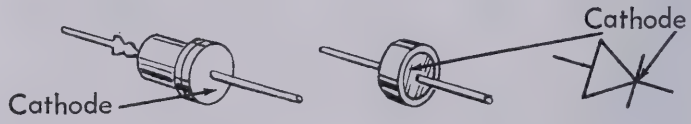


Turn the rotary switches to the maximum counter-clockwise position. The exact position of the lugs referred to are determined by looking at the switch from the view shown in figures 5, 7 and 8.

On rotary switches, the front of the wafer is assigned one letter of the alphabet and the rear a second letter. If there is more than one wafer (such as is the case for S1 illustrated in the construction steps), the sides of the wafers are assigned more letter in sequence. Thus the front of the second wafer is assigned letter "C" while the rear of the wafer has been assigned letter "D". In the single wafer switch shown in Figure 8, S2A-11 refers to switch S2, the front of the wafer, solder lug #11.

SILICON RECTIFIERS

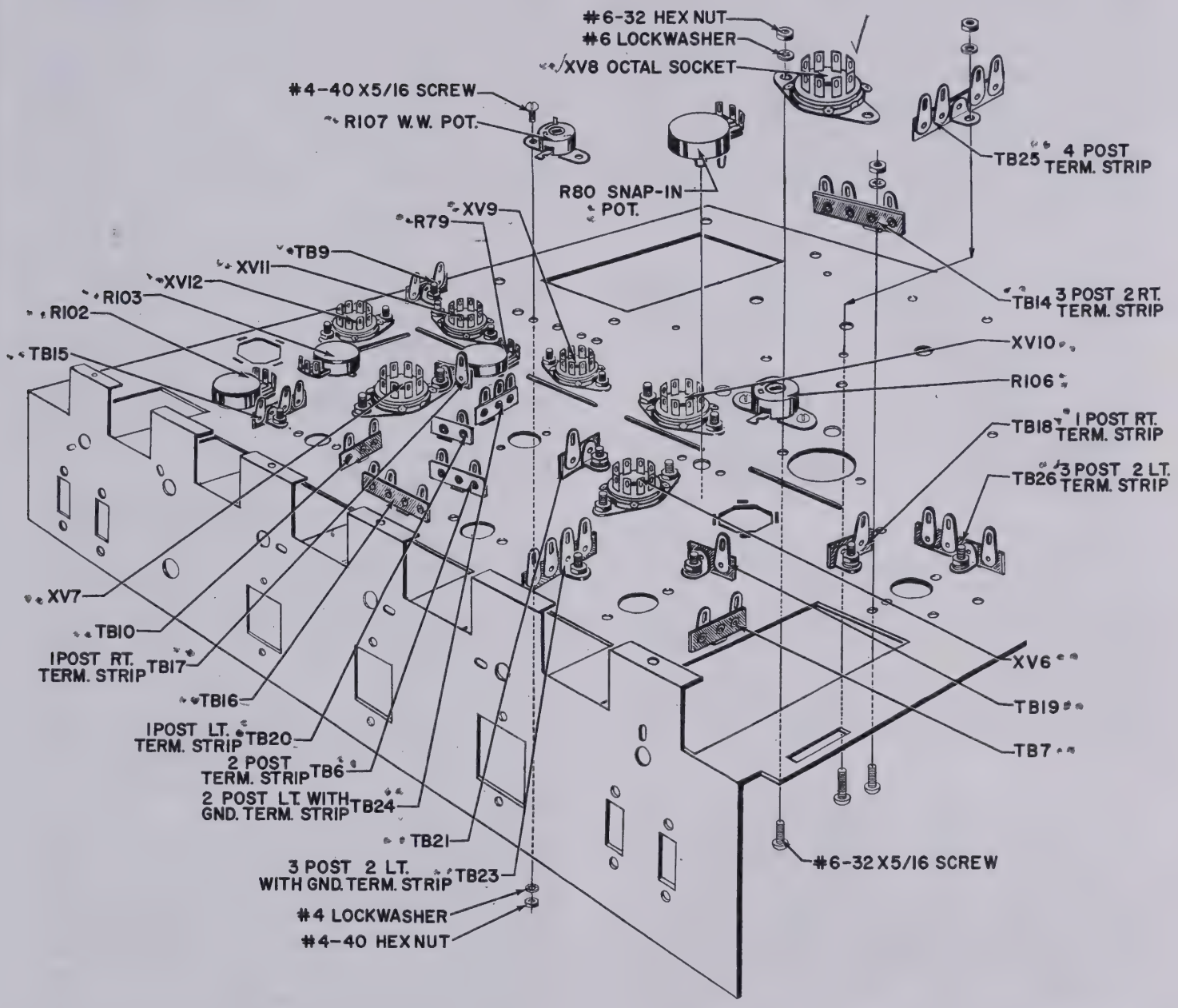
Silicon rectifiers, symbol CR, are solid state diodes. One end is the cathode (+). On the second end is the anode (-). Two popular shapes of rectifiers are illustrated. The cathode end is pointed out in each case.



When other shapes of rectifiers are supplied, the symbol for the rectifier, shown in the figure, is usually printed on the unit. The lead near the end indicated by the symbol as the cathode, protrudes from the cathode side of the rectifier. If there is no symbol, a red dot will indicate the cathode. Connect the cathode lead of any of these rectifiers to the proper lug, when so indicated in the construction step below.

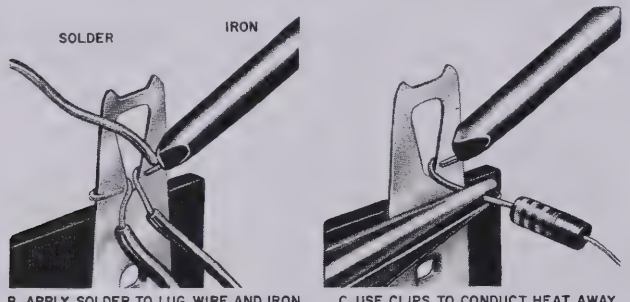
HARDWARE

Hardware is a general term for mechanical parts used in the assembly of EICO kits. Such items are



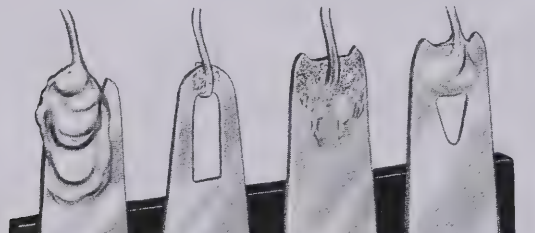
BOTTOM CHASSIS ASSEMBLY FIGURE 1

First make a good mechanical connection. Remove 1/4" of insulation from the end of the wire. Feed the wire through the solder lug opening so that the wire insulation just touches the lug. With the long-nose pliers, bend the wire lead around the lug and crimp the wire lead to the lug. Now solder this wire. Place the tip of the hot soldering iron on the lug or terminal at a point close to the wire being soldered. Apply the solder to the junction of the lug, wire and soldering iron. When the lug and wire have been heated sufficiently, the solder will flow into and over the joint. Remove the iron when the solder starts to flow and remove the solder immediately after. Use only enough solder to cover the wire at the connection point.



B. APPLY SOLDER TO LUG, WIRE AND IRON C. USE CLIPS TO CONDUCT HEAT AWAY

A poor solder connection is obvious by its appearance. A grainy or pitted joint is a poor connection due to insufficient heat. Blobs of solder on the wire or solder lug is also due to insufficient heat. Solder should flow as a result of the heated lug and wire. Do not solder by applying solder to the iron tip and then wiping the hot solder onto the joint. A well soldered joint is indicated by a smooth shiny finish on the soldered connection.


D. TOO MUCH SOLDER TOO LITTLE SOLDER COLD JOINT GOOD CONNECTION

Construction Hints: The various lengths of wire to be used in the kit are specified in the construction steps. After cutting the wire to the length specified, strip the insulation off 1/4" from each end. The exposed wire will be used to make the actual connection to the solder lug.

Shielded wire sizes are also indicated in the specific construction step. In the particular step you will be told just how much of the outer insulation must be removed and just how long the shield strands and inner conductor (s) must be.

Components, such as resistors, capacitors, transformers, etc., may have longer leads than specified. Cut the leads to the length indicated in the particular step. This length is to be measured from the body of the component. In the case of insulated leads, strip 1/4" of insulation off from the ends and twist the strands (if any) of the wire together.

As an example, one step may specify that each lead on a resistor be cut to 1/2". 1/4" of each lead is used to make a mechanical connection to the solder lug. The other 1/4" is between the socket and the component so that the component will not be overheated when soldering.

When a connection is indicated, a (C) or an (S) will appear next to the lug involved. The (C) indicates that the connection should be made mechanically, but is not to be soldered yet, since other leads are to be connected to this same lug. The (S) indicates that the connection should be made and soldered immediately. However, the (S) is always followed by a number, such as (S1), (S2), (S3), etc. This number indicates the number of connections made to the lug. It is a check on the accuracy of your work.

As an example, if it says (S3), you should count three leads going to the lug to be soldered. If there are less than three leads at this particular lug, you will know that you have forgotten one or more leads, or connected them to the wrong lugs. If there are more than three leads, you can be certain you have connected an extra wire to this lug, which should probably go elsewhere.

When you assemble the components in your unit, mark the symbol number of each socket and terminal strip near the part with a crayon. This will facilitate your wiring operation.

When wiring, lay the component in close to the chassis, dress as shown in the drawing. Be careful to avoid shorts at the lugs. The book is written so that the wiring closest to the chassis usually gets wired in first. The next layer of wires are to be soldered in next. In each case, dress the leads and components as close to the chassis as possible.

Next to each step number you will find a parenthesis ( ). After you have completed each step, make a check mark in the parenthesis so that you will have a record of your work. Follow the steps in the sequence given in the book. Do not skip steps or pages.

If any addenda are included in your book to modernize your instrument or make corrections or part substitutions, be sure to correct the Construction Book first before you start to wire or assemble your kit.

You are now ready to construct your fine stereo dual power amplifier.

spaghetti. Cut the inner conductor to 1/2" and strip back the inner insulation to 1/4". This end will be connected later.

( ) 13. On one end of a 19" piece of black single conductor shielded cable, strip the outer insulation back 1/2". Twist the shield strands together. Strip the insulation of the inner conductor back 1/4". Connect the twisted shield strands to J13, 14, 15-2 (S2). Connect the inner conductor to J13, 14, 15-1 (S1).

On the other end of the same piece of shielded cable, strip the outer insulation back 1/2". Twist the shield strands together and cut them off. Strip the insulation of the inner conductor back 1/4". This end will be connected later.

( ) 14. Connect a 1 1/4" piece of bare wire from TB3-1 (C) to ground lug "Z" (S1).

( ) 15. Cut a 25" piece of green wire, a 25" piece of grey wire, a 24 1/2" piece of yellow wire, a 25" piece of violet wire, a 25 1/2" piece of white wire, a 26" piece of red wire, a 25" piece of brown wire and a 30" piece of black wire. Strip back 1/4" of insulation from both ends of each of the wires. Lay the wires on a table so that they are all even on one end. 1 1/2" from this end, twist the eight leads together for a length of 16". On the other end of this twisted group of wires, connect the red lead to TB2-1 (S1), the white lead to TB2-2 (S1), the violet lead to TB2-3 (S1), the yellow lead to TB2-4 (S1), the grey lead to TB3-2 (C), the green lead to TB3-4 (C) and the brown lead to TB5-1 (C). Do not connect the black lead yet. The other ends of the eight leads will be connected later.

( ) 16. Connect a 1 1/4" piece of bare wire from TB4-1 (S1) to TB1-1 (C).

( ) 17. Cut all leads on two 6K (blue, black, red, gold) 5% resistors, R85 and R86, to 1/2". Connect R85 from TB5-2 (C) to TB1-4 (C). Connect R86 from TB4-2 (C) to TB3-4 (C).

( ) 18. Cut all leads on two 125mmf disc capacitors, C35 and C36, to 1/2". Connect C35 from TB5-2 (C) to TB1-4 (C). Connect C36 from TB4-2 (C) to TB3-4 (C).

( ) 19. Cut both leads on the 5.3K (green, orange, red, gold) 5% resistor, R89 to 1/2". Connect from TB5-1 (S2) to TB5-2 (C).

( ) 20. Connect a 4" piece of black wire from J16-1 (C) to J17-1 (S1).

( ) 21. Connect a 2" piece of black wire from XF1-1 (S1) to J16-1 (C).

The following steps refer to figure 5.

Turn the switch, S1, to its maximum counter-clockwise position. The switch is shown in the figure from the rear view. The exact position of the lugs referred to are determined by looking at the switch from the view shown in the figure. Each side of the wafer has been assigned a letter. Each lug has been assigned a number. The lug is referred to by the wafer number and lug designation. Thus lug S1D-3 refers to selector switch S1, the "D" side of the wafer (rear side of the second wafer side facing you when holding the switch as shown in the drawing) and 3 refers to the lug on this particular side of the wafer.

( ) 1. On both ends of a 4" piece of black single conductor shielded cable, strip the insulation back 1/2". On one end, cut off the shield strands. On the other end, twist the shield strands together. Strip back the insulation from the inner conductor 1/4" from both ends. Connect the twisted shield strands to S1A-10 (C) and the inner conductor on this end to S1B-11 (S1). The other end will be connected later.

( ) 2. On both ends of a 3" piece of black single conductor shielded cable, strip the insulation back 1/2". On one end, cut off the shield strands. On the other ends, twist the shield strands together. Strip back the insulation from the inner conductor 1/4" from the ends. Connect the twisted shield strands to S1H-11 (C) and the inner conductor on this end to S1G-12 (S1). The other end will be connected later.

( ) 3. On one end of a 4" piece of grey single conductor shielded cable, strip the outer insulation back 1 1/4". Twist the shield strands together and cover them with a 1" piece of thick spaghetti. Cut the inner conductor to 1/2" and strip back 1/4" of the insulation. Connect the inner conductor to S1B-5 (S1) and the shield strands to S1A-10 (C).

On the other end of the same piece of shielded cable, strip the outer insulation back 1/2". Twist the shield strands together. Strip back 1/4" of the insulation from the end of the inner conductor. This end will be connected later.

( ) 4. On both ends of a 4" piece of grey single conductor shielded cable, strip the outer insulation back 1/2". On one end, cut off the shield strands. On the other end, twist the shield strands together.

( ) 5. Cut all leads on the two 47KΩ (yellow, violet, orange, silver) resistors R1, R2 to 1/2". Connect R1 from J1, 2, 3-2 (C) to J1, 2, 3-3 (C). Connect R2 from J4, 5, 6-2 (C) to J4, 5, 6-3 (C).

( ) 6. Cut all leads on the two 100KΩ (brown, black, yellow, silver) resistors R3, R4 to 1/2". Connect R3 from J1, 2, 3-4 (C) to J1, 2, 3-5 (S2). Connect R4 from J4, 5, 6-4 (C) to J4, 5, 6-5 (S2).

( ) 7. Cut a 13 1/2" length of 3 conductor shielded cable. On one end, strip back 1" of the outer insulation. Twist the shield threads together. Cut these strands to 1" and cover them with a 3/4" piece of thick spaghetti. Strip back the insulation 1/4" from the end of each of the inner conductors. Connect the twisted shield strands to J4, 5, 6-2 (S3), the orange lead to J4, 5, 6-1 (S1), the red lead to J4, 5, 6-3 (S2) and the brown lead to J4, 5, 6-4 (S2).

On the other end of the same shielded cable, strip back 1" of the outer insulation. Twist the shield strands together. Cut these strands to 1". Cover them with a 3/4" piece of thick spaghetti. Strip back the insulation 1/4" from the end of each of the inner conductors. This end of the cable does not get connected until later.

( ) 8. Cut a 15 1/2" length of 3 conductor shielded cable. On one end, strip back 1" of the outer insulation. Twist the shield strands together. Cut the shield strands to 1" and cover them with a 3/4" piece of thick spaghetti. Strip back the insulation 1/4" from the end of each of the inner conductors. Connect the twisted shield strands to J1, 2, 3-2 (S3). The orange lead to J1, 2, 3-1 (S1). The red lead to J1, 2, 3-3 (S2) and the brown lead to J1, 2, 3-4 (S2).

On the other end of the same shielded cable, strip back 1" of the outer insulation. Twist the shield strands together. Cut these strands to 1". Cover them with a 3/4" piece of thick spaghetti. Strip back the insulation 1/4" from the end of each of the inner conductors. This end of the cable does not get connected until later.

( ) 9. Cut a 17 1/2" length of shielded 3 conductor cable. On one end strip back 1" of the outer insulation. Twist the shield strands together. Cut the shielded strands to 1" and cover them with a 3/4" piece of thick spaghetti. Strip back the insulation 1/4" from the end of each of the inner conductors. Connect the twisted shield strands to J7, 8, 9-2 (S2), the orange lead to J7, 8, 9-4 (S1), the red lead to J7, 8, 9-3 (S1) and the brown lead to J7, 8, 9-1 (S1).

On the other end of the same shielded cable, strip back 1 1/4" of the outer insulation. Twist the shield strands together. Cover the shield strands with a 1" piece of thick spaghetti. Strip back the insulation 1/4" from the end of each of the inner conductors. This end of the cable does not get connected until later.

( ) 10. Cut a 19 1/2" too long length of shielded 3 conductor cable. On one end strip back 1" of the outer insulation. Twist the shield strands together. Cut the shielded strands 1" and cover them with a 3/4" piece of thick spaghetti. Strip back the insulation 1/4" from the end of each of the inner conductors. Connect the twisted shield strands to J10, 11, 12-2 (S2), the orange lead to J10, 11, 12-4 (S1), the red lead to J10, 11, 12-3 (S1) and the brown lead to J10, 11, 12-1 (S1).

On the other end of the same shielded cable, strip back 1 1/2" of the outer insulation. Twist the shield strands together. Cut these strands to 1 1/2". Cover them with a 1" piece of thick spaghetti. Strip back the insulation 1/4" from the end of each of the inner conductors. This end of the cable does not get connected until later.

( ) 11. On one end of a 19" piece of black single conductor shielded cable, strip the outer insulation back 1/2". Twist the shield strands together. Strip the insulation of the inner conductor back 1/4". Connect the twisted shield strands to J13, 14, 15-5 (S1). Connect the inner conductor to J13, 14, 15-4 (S1).

On the other end of the same piece of shielded cable, strip the outer insulation back 1 1/2". Twist the shield strands together. Cover with a 1 1/4" piece of thick spaghetti. Cut the inner conductor to 1/2" and strip back the inner insulation to 1/4". This end will be connected later.

( ) 12. On one end of a 19" piece of grey single conductor shielded cable, strip the outer insulation back 1/2". Twist the shield strands together. Strip the insulation of the inner conductor back 1/4". Connect the twisted shield strands to J13, 14, 15-2 (C). Connect the inner conductor to J13, 14, 15-3 (S1).

On the other end of the same piece of shielded cable, strip the outer insulation back 1 1/4". Twist the shield strands together. Cut the shield strands to 1 1/2" and cover it with a 1 1/4" piece of thick

The following steps refer to figure 7.

( ) 1. Run the group of eight twisted leads along the chassis, as shown. Dress the leads along the chassis using two metal cable clamps. Secure the two cable clamps to the chassis using two #6-32 x 5/16 screws, two #6 lockwashers and two #6-32 hex nuts. Note that one cable clamp is located in a hole near the power transformer mounting cut-out and a second cable clamp is located in a hole near the electrolytic can capacitor, C43. Mount a #6 ground lug below the chassis using the same screw previously used in the mounting of the cable clamp located near C43. See Figure 9.

( ) 2. Connect a 1 1/4" piece of bare wire covered with a 7/8" piece of spaghetti from S9-3 (C) to S9-4 (S1).

( ) 3. Connect a 1 1/4" piece of bare wire covered with a 7/8" piece of spaghetti from S9-6 (S1) to S9-1 (C).

( ) 4. Connect a 5/8" piece of bare wire from S8-5 (C) to S8-8 (S1).

( ) 5. From the twisted leads, connect the red wire to S9-5 (S1), the violet wire to S9-1 (S2), the white wire to S9-2 (S1), the yellow wire to S8-4 (S1) the grey wire to S8-5 (S2), the green wire to S8-2 (S1), the brown wire to S8-3 (S1) and the black wire to S8-9 (S1).

( ) 6. Connect a 3" piece of violet wire from S8-7 (S1) to S9-3 (S2).

( ) 7. Connect one end of a 16" piece of yellow wire to XI1-2 (S1) and one end of a 15" piece of brown wire to XI1-1 (S1). Twist the leads together and run them along the front panel, as shown. Dress these leads away from potentiometers R47, R48, S10. Push the other end of the twisted pair through *hole "L" to the bottom side of the chassis.*

NOTE: Two printed circuit plates are soldered to the dual potentiometers. One printed circuit plate, PC1, gets connected to the potentiometers R45 and R47, nearest the front apron. The other printed circuit plate, PC2, gets connected to the potentiometers R46 and R48 mounted on the rear of the front potentiometers. To keep the drawings clear and simple, the first plate, PC1, is mounted and wired in first, with the associated connections. The rear potentiometer is shown dotted in.

In figure 8, the second plate, PC2 is mounted and wired into the circuit, with its associated connections. In this drawing, the front potentiometer, R45, is shown dotted in. All the connections made previously for PC1 are not shown in this drawing to avoid confusion.

( ) 8. On one end of an 8 1/2" piece of grey single conductor shielded cable, strip the outer insulation back 1/2". Twist the shield strands together and cut them off. Strip back 1/4" of the insulation from the inner conductor and connect it to R47-3 (C).

On the other end of the same cable, strip the outer insulation back 3/4". Twist the shield strands together. Strip back 1/4" of the insulation from the inner conductor and connect it to S6-4 (C). Connect the twisted shield strands to TB12-1 (C).

( ) 9. On printed circuit PC1, cut leads #2, #3 and #6 to 1/2"; cut leads #1, #4, #5 and #7 to 2" and cover each of these with 1 3/4" pieces of spaghetti. Place the plate against the panel in the direction shown, so that lead #2 is next to lug R45-1 and lead #6 is next to lug R45-3. Dress the leads so that they are all pointing towards you, away from the front panel. Connect lead #6 to R45-3 (S1), lead #3 to R45-2 (S1), lead #2 to R45-1 (S1), lead #7 to R47-1 (C), lead #4 to R47-2 (S1), lead #1 to R47-3 (S2) and lead #5 to TB13-1 (C).

( ) 10. On one end of a 4" piece of black single conductor shielded cable, strip the outer insulation back 7/8". Twist the shield strands together and cover them with a 3/4" piece of thick spaghetti. Cut the inner conductor to 1/2" and strip back 1/4" of the insulation.

On the other end of the same cable, strip the outer insulation back 1/2". Twist the shield strands together and cut them off. Strip back 1/4" of the insulation from the inner conductor and connect it to TB13-1 (S2). Push the end previously prepared through hole "J" to the bottom of the chassis.

( ) 11. On one end of a 7 1/2" piece of grey single conductor shielded cable, strip the outer insulation back 3/4". Twist the shield strands together and cover them with a 5/8" piece of thick spaghetti. Strip back 1/4" of the insulation from the inner conductor.

On the other end of the same cable, strip the outer insulation back 1/2". Twist the shield strands together and cut them off. Strip back 1/4" of the insulation from the inner conductor and connect it to TB13-2 (C). Push the end previously prepared through hole "J" to the bottom of the chassis.

The following steps refer to figure 6.

In this figure, all components mounted to the front chassis panel are shown. Note that this is not the actual decorative and separate front panel which contains all the descriptive nomenclature. This panel is an integral part of the main chassis. Note that the view in the drawing is from the rear of the chassis. Switch S1 has already been mounted.

( ) 1. Mount three DPDT slide switches, S3, S4 and S9, as shown, in the smaller rectangular holes on the panel. Use two #4-40 x 1/4 flat head screws, two #4 lockwashers and two #4-40 hex nuts on each.

( ) 2. Mount the four 4PDT slide switches, S5, S6, S7 and S8, as shown, in the remaining four larger rectangular holes in the front chassis panel. Use two #4-40 x 1/4 flat head screws, two #4 lockwashers and two #4-40 hex nuts on each. On switch S6 mount the two post terminal strip, TB12, as shown.

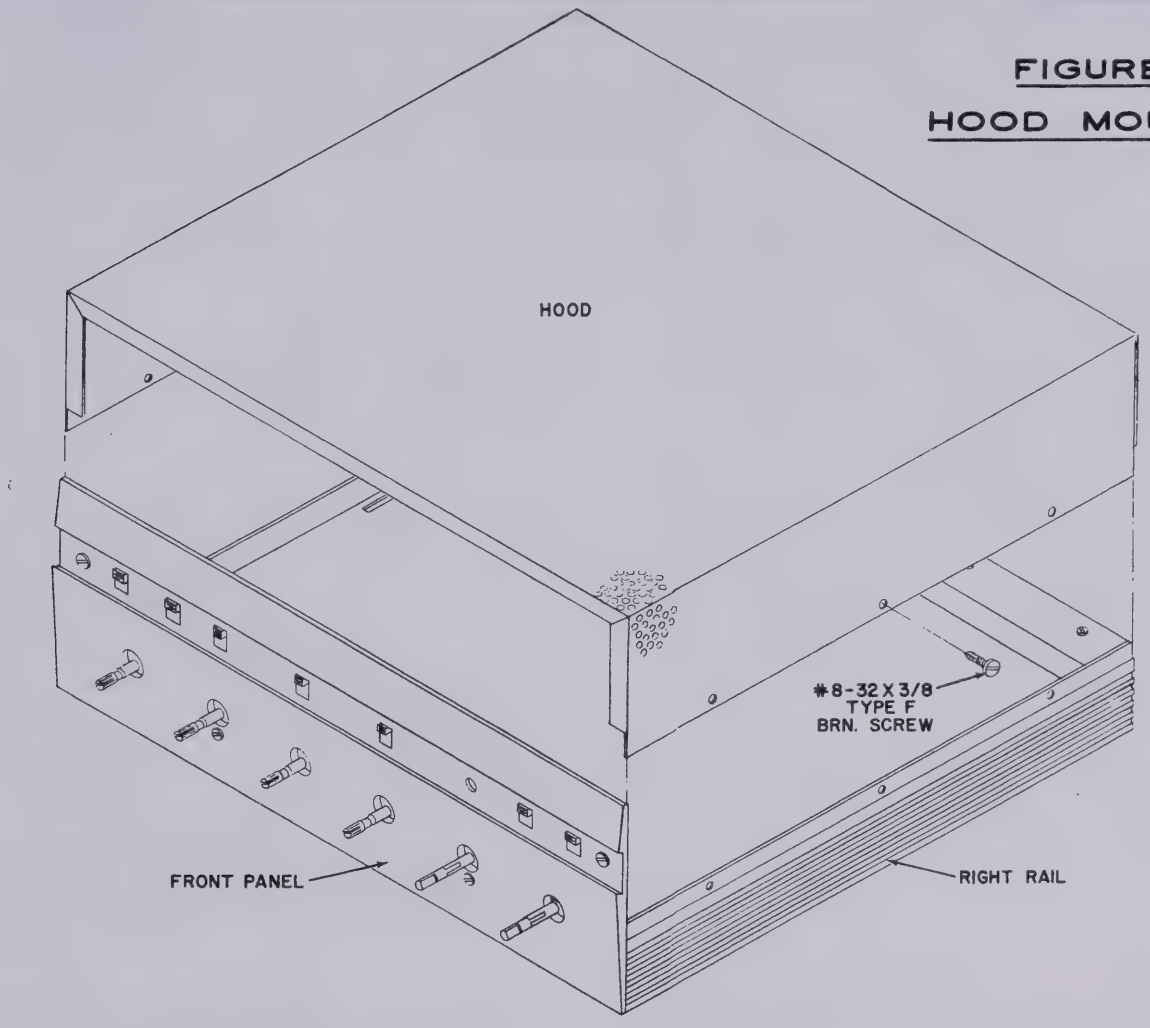
( ) 3. Push the pilot light bulb into its socket XI1 and place the bulb shield over the bulb. Mount the pilot light assembly XI1 to the front panel using one #4-40 x 1/4 flat head screw, one #4 lockwasher and one #4-40 hex nut. Orient the socket so that the bulb is right opposite the round hole in the panel which is located midway between S7 and S8. Now, tighten the hex nut onto the screw while holding the socket in this position.

( ) 4. Next to the rotating shaft, on the front plate of each potentiometer and rotary switch, you will find a small locating lug. Next to the round 3/8" mounting hole for each potentiometer and rotary switch (in the front chassis panel) you will find a small, eliptically-shaped hole. The rotating shaft and bushing on the control fit through the round hole while the locating lug fits through the adjacent eliptical hole when the control is oriented in proper direction on the panel.

Mount dual 750K potentiometer R31, 32; dual 250K potentiometer R33, 34; concentric 1M potentiometer R45,46; and concentric 500K potentiometer with switch R47, 48, S10, in the proper locations on the front chassis panel, as shown in the drawing. Orient each control so that the locating lug fits into its appropriate and adjacent eliptical hole. Between each hex nut and the panel, place a 3/8" lockwasher. Secure each control to the panel using a 3/8" hex nut.

( ) 5. Following the above procedure, mount the single wafer rotary switch S2 at the appropriate location on the front chassis panel. Orient the switch so that the locating lug fits into the adjacent eliptical hole. Between the hex nut and the panel, place a 3/8" lockwasher. Secure the switch to the panel using a 3/8" hex nut.

FIGURE 14
HOOD MOUNTING



check the wiring for errors or reversed connections and continuity.

( ) 13. If the amplifier is to be mounted in a console, read carefully the "Mechanical Installation" section of the instructions and follow the procedures outlined.

( ) 14. Detailed information as to connection of phonographs, tuners, etc., to the amplifier inputs and speaker systems to the amplifier outputs, as well as a-c line connections and use of the hum adjustment control, is given in the "Electrical Installation" section.

SERVICE

If you are still having difficulty, write to our service department listing all possible indications that might be helpful. Note the code numbers printed in red under the word "Manual" on the front cover. If there is no code number, state this. If desired, you may return the amplifier to our factory where it will be placed in operating condition for $13.50 plus the cost of parts replaced due to their being damaged in the course of construction. This service policy applies only to completed amplifiers constructed in accordance with the instructions as stated in the manual. Amplifiers that are not completed or are modified will not be accepted for repair. Amplifiers that show evidence of acid core solder or paste fluxes will be returned not repaired. NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the amplifier, giving your home address and the trouble with the unit. Pack very carefully in a rugged container, using sufficient packing material (cotton, shredded newspaper, or excelsior), to make the unit completely immovable within the container. The original shipping carton is satisfactory, providing the original inserts are used or sufficient packing material is inserted to keep the amplifier immovable. Ship by prepaid Railway Express, if possible, to the Service Dept., Electronic Instrument Co., Inc., 33-00 Northern Blvd., L.I.C. 1, New York. Return shipment will be made by express collect. Note that the carrier cannot be held liable for damages in transit if packing, IN HIS OPINION, is insufficient.

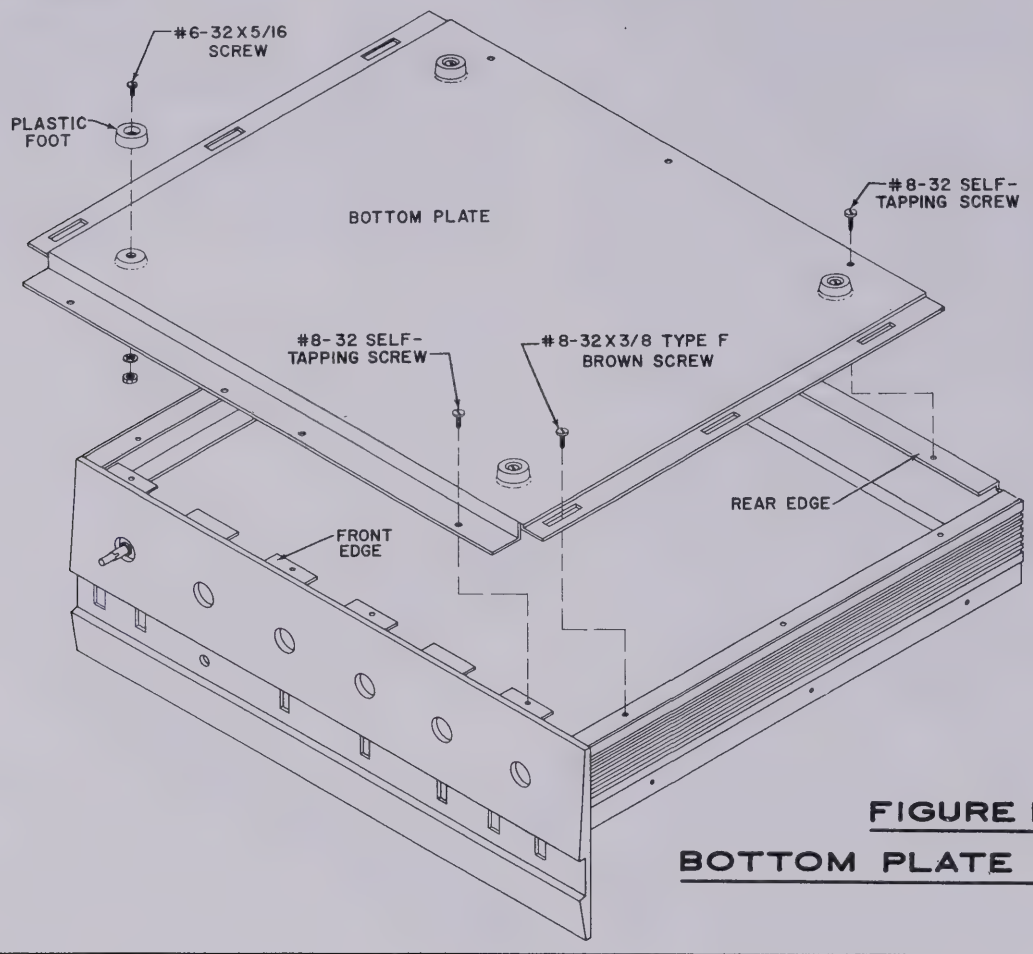


FIGURE 13
BOTTOM PLATE MOUNTING

screws. Do not tighten the screws on the front edge or side rails at this time.

Apply pressure to the center and front surface of the front panel. While doing this, first tighten the four screws holding the bottom plate to the front edge of the chassis and finally the six screws holding the bottom plate to the two side rails.

The following step refers to Figure 14.

( ) 10. Mount the hood over the side rails but behind the panel. Secure the hood to the side rails using six #8-32 x 3/8 Type F brown self tapping screws. Turn unit on its side and adjust panel to hood.

( ) 11. Set all controls to the maximum counter-clockwise position. Mount one of the larger dual knobs on the SELECTOR switch shaft, with the marker pointing to TAPE/AUX; mount a second knob on the MODE switch shaft, with the marker pointing to ✓CH. 1; mount a third knob on the BALANCE control shaft, with the marker pointing to the line just below the "4"; mount the fourth knob on the LEVEL control shaft, with the marker pointing to the line just below the "1". Mount one of the outer concentric knobs on the outer shafts of the BASS control with the marker pointing approximately to the line just below the "-4"; mount one of the outer concentric knobs on the outer shaft of the TREBLE control with the marker pointing approximately to the line just below the "-4". Mount the two inner concentric knobs on the inner shafts of the BASS and TREBLE controls so that the flats on the shafts line up with the flats on the knobs.

( ) 12. OPERATIONAL CHECKS ON COMPLETED KITS: In the INSTRUCTION part of this manual you will find a section titled "Electrical Installation." Read this carefully and connect your speakers, phonograph, and tuners to the amplifier in accordance with the instructions given. Then read the section title "Operating Instructions" and operate all the controls, checking aurally for the results described. If the amplifier does not operate at all or operates incorrectly, use the TROUBLE-SHOOTING chart and the VOLTAGE & RESISTANCE chart to discover and remedy the difficulty. As the Trouble Shooting Chart presumes a properly wired amplifier, which may not be the case, re-

( ) 11. Cut all leads on two 68mmf disc capacitors, C11 and C12, to 3/4". Connect C12 from TB11-1 (S2) to S5-3 (S1). Cover one end of C11 with a 1/2" piece of spaghetti and connect to S5-9 (S1). Connect the other end of C11 to TB11-2 (S2).

( ) 12. Connect a 3 1/2" piece of yellow wire from S1E-4 (S1) to S2A-8 (C).

( ) 13. Cut all leads on two 6.8K (blue, grey, red, silver) resistors, R29 and R30, to 1/2". Connect R29 from S2B-2 (S2) to S2B-3 (S1). Connect R30 from S2A-8 (S2) to S2B-9 (S1).

( ) 14. From S1D-8 (S1) connect the blue lead to S4-6 (S1).

( ) 15. From S1E-9 (S1) connect the brown lead to S4-3 (S1).

( ) 16. Run the black and the grey shielded cables from hole "AA" along the chassis, as shown. Secure it to the chassis using two metal cable clamps. Mount one cable clamp to the chassis using the hole next to TB27 and mount the second cable clamp using the hole near output transformer T2. Use one #6-32 x 5/16 screw, one #6 lockwasher and one #6-32 hex nut to secure each clamp to the chassis.

( ) 17. Connect the center conductor from the black shielded cable to S2B-4 (S2).

( ) 18. Connect a 3" piece of black wire from S1F-6 (C) to S2A-11 (C).

( ) 19. Connect the twisted strands from the grey shielded cable to S2A-11 (S2) and the center conductor to S2B-7 (S2).

( ) 20. Cut all leads on two 2.7K (red, violet, red, silver) resistors, R35 and R36, to 1/2". Connect R35 from S5-10 (C) to S5-11 (S1). Connect R36 from S5-4 (C) to S5-5 (S1).

( ) 21. Connect a 5" piece of black wire from TB12-1 (S4) to TB27-1 (C).

( ) 22. Connect a 5" piece of black wire from TB12-2 (S4) to TB27-2 (C).

( ) 23. Cut all leads on two .2mfd disc capacitors, C13 and C14, to 1". Connect C13 from S5-10 (S2) to TB27-1 (S2). Connect C14 from S5-4 (S2) to TB27-2 (S2).

( ) 24. Connect a 1" piece of bare wire from S1F-6 (S3) to S1C-6 (S4).

( ) 25. Connect a 3/4" piece of bare wire from S1E-1 (S1) to S1E-2 (C).

( ) 26. Connect a 1 1/2" piece of blue wire from S1G-1 (S1) to S1G-4 (C).

( ) 27. Cut all leads on two 150K (brown, green, yellow, silver) resistors, R23 and R24, to 1/2". Connect R23 from S3-2 (C) to S3-3 (C). Connect R24 from S3-5 (C) to S3-6 (C).

( ) 28. Cut all leads on two 680K (blue, grey, yellow, silver) resistors, R25 and R26 to 1/2". Connect R25 from S3-1 (C) to S3-2 (S2). Connect R26 from S3-4 (C) to S3-5 (S2).

( ) 29. Cut all leads on two 330mmf disc capacitors, C5 and C6, to 3/4". Connect C5 from S1B-4 (S1) to S1C-4 (C). Connect C6 from S1F-5 (C) to S1G-5 (S1).

( ) 30. Connect one end of a 3" piece of blue wire to S1C-4 (S2) and one end of a 3" piece of green wire to S1C-2 (S1). Twist the two leads together. Connect the other end of the blue lead to S3-1 (S2) and the other end of the green lead to S3-3 (S2).

( ) 31. Connect one end of a 3 1/2" piece of white wire to S1F-5 (S2) and one end of a 4" piece of violet wire to S1F-3 (S1). Twist the two leads together. Connect the other end of white lead to S3-4 (S2) and the other end of the violet lead to S3-6 (S2).

( ) 32. Cut all leads on two 200K (red, black, yellow, gold) resistors, R5 and R6, to 1/2". Connect R5 from S1B-1 (C) to S1B-3 (C). Connect R6 from S1G-2 (C) to S1G-4 (C).

( ) 33. Cut all leads on two 400mmf disc capacitors, C1 and C2, to 1/2". Connect C1 from S1B-1 (C) to S1B-3 (S3). Connect C2 from S1G-2 (C) to S1G-4 (S3).

( ) 34. Cut all leads on two 4MΩ (yellow, black, green, gold) resistors, R9 and R10, to 3/4". Connect R9 from S1B-1 (C) to S1D-1 (C). Connect R10 from S1E-2 (C) to S1G-2 (C).

( ) 35. Cut all leads on a .0012mfd (1.2K or 1200 mmf) disc capacitors, C3 and C4, to 3/4". Connect C3 from S1B-1 (S4) to S1D-1 (S3). Connect C4 from S1E-2 (S3) to S1G-2 (S4).

The following step refers to figure 9.

In the drawing, the back panel is shown laying next to the rear side of the main chassis. Actually, the panel has already been attached to the main chassis. It is drawn in this fashion to clarify the ensuing wiring steps.

( ) 1. From hole "A", connect the black lead to TB25-4 (C).

( ) 2. From hole "L", run the twisted pair of brown and yellow leads along the chassis as shown. Connect the brown lead to XV11-2 (C) and the yellow lead to XV11-7 (C).

( ) 3. From rectangular cutout "K" at the front of the chassis, run the two black leads along the chassis as shown. Connect the shorter lead to J16-2 (C) and the longer lead to J17-2 (C).

( ) 4. From rectangular cutout "J", connect the inner conductor from the black cable to XV3-7 (C) and the spaghetti covered outer shield to TB15-1 (C).

( ) 5. From rectangular cutout "J", connect the inner conductor from the grey cable to XV4-7 (C) and the spaghetti covered outer shield to TB16-1 (C).

( ) 6. From rectangular cutout "I", connect the orange lead to R33-3 (C), the white lead to R34-6 (C), the grey lead to TB6-1 (C) and the blue lead to TB6-2 (C).

( ) 7. From rectangular cutout "H", connect the green lead to TB16-2 (C), the grey lead to R31-3 (S1), the short white lead to R32-5 (C), the longer white lead to TB16-3 (C), the blue lead to XV5-7 (C), the yellow lead to XV5-2 (C), the brown lead to R31-2 (C) and the red lead to R32-4 (S1).

( ) 8. From the large rectangular cutout "F" and switch S1, connect the black lead from S1C-6 to TB7-2 (C), the green lead from S1D-7 to TB23-1 (C), the orange lead from S1F-8 to TB14-3 (C), the black lead from S1H-11 to TB14-2 (C), the center conductor from the grey shielded lead connected to S1B-5 and S1B-10 to TB7-1 (C) and the shield leads to TB7-2 (C), the center conductor from the black shielded lead connected to S1B-11 and S1A-10 to XV1-8 (C), the center conductor from the black shielded lead connected to S1G-12 and S1H-11 to XV2-8 (C), and the center conductor from the grey shielded lead connected to S1G-6 to TB14-1 (C) and the shield strands to TB14-2 (C).

( ) 9. Connect a 3" piece of green wire from R34-5 (C) to XV4-2 (S1).

( ) 10. Connect a 4" piece of green wire from R33-2 (C) to XV3-2 (S1).

( ) 11. Cut both leads on a 220K (red, red, yellow, silver) resistor, R42, to 3/4". Connect from TB16-2 (C) to R34-5 (S2).

( ) 12. Connect a 2 1/4" piece of black wire from R34-6 (S2) to TB16-1 (C).

( ) 13. Connect a 5" piece of black wire from R33-3 (S2) to TB15-1 (C).

( ) 14. Connect a 3 1/2" piece of grey wire from R31-2 (S2) to R33-1 (S1).

( ) 15. Connect a 3 1/2" piece of white wire from R32-5 (S2) to R34-4 (S1).

( ) 16. Cut both leads on a 220K (red, red, yellow, silver) resistor, R41, to 1". Cover one lead with a 3/4" piece of spaghetti and connect to R33-2 (S2). Connect the other lead to TB16-3 (C).

( ) 17. Connect one end of an 8" piece of brown wire to XV3-5 (C) and one end of a 9" piece of yellow wire to XV3-9 (C). Twist the leads together and run them along the chassis as shown. Connect the other end of the yellow wire to XV1-9 (S1) and the other end of the brown wire to XV1-4 (C).

( ) 18. Connect a 1/2" piece of bare wire from XV1-4 (S2) to XV1-5 (S1).

( ) 19. Connect a 1/2" piece of bare wire from XV3-4 (S1) to XV3-5 (C).

( ) 20. Connect one end of a 3 1/2" piece of brown wire to XV3-5 (S3) and one end of a 3 1/2" piece of yellow wire to XV3-9 (S2). Twist the leads together and run them along the chassis as shown. Connect the other end of the brown wire to XV7-8 (C) and the other end of the yellow wire to XV7-7 (C).

( ) 21. Connect one end of a 3 1/2" piece of brown wire to XV7-8 (C) and one end of a 4" piece of yellow wire to XV7-7 (C). Twist the leads together

BOTTOM CHASSIS WIRING (CON'T.)

The following steps refer to figure 10.

(✓) 1. Cut all leads on three 10K (brown, black, orange, silver) 2 watt resistors, R91, R92 and R93, to 3/4". Connect R92 from TB25-2 (S2) to TB25-3 (C). Connect R91 from TB25-3 (C) to TB25-1 (C). Connect R93 from C42-C (C) to C42-D (C).

(✓) 2. Connect a 6 1/2" piece of red wire from TB26-3 (C) to TB19 (C).

(✓) 3. Connect a 5" piece of red wire from C42-C (C) to TB23-2 (C).

(✓) 4. Connect a 6" piece of red wire from C42-D (S2) to TB8-2 (C).

(✓) 5. Connect a 7" piece of red wire from C42-B (C) to TB20 (C).

(✓) 6. Connect a 5" piece of red wire from C42-A (C) to TB21 (C).

(✓) 7. Connect a 6" piece of red wire from TB21 (C) to TB17 (C).

(✓) 8. Connect a 5" piece of red wire from TB17 (C) to TB15-3 (C).

(✓) 9. Connect a 4 1/2" piece of red wire from TB8-2 (C) to TB10-2 (C).

(✓) 10. Cut all leads on two 120K (brown, red, yellow, silver) resistors, R94 and R95 to 1/2". Connect R94 from C42-C (C) to TB19 (C). Connect R95 from C42-A (C) to C42-B (S2).

(✓) 11. Cut both leads on a 2.2K (red, red, red, silver) resistor, R97, to 1". Cover each lead with a 3/4" piece of spaghetti. Connect from XV8-8 (S3) to C42-A (C).

(✓) 12. Cut both leads on a 10mfd, 25 volt electrolytic capacitor, C46, to 3/4". Connect the positive (+) lead to TB26-1 (C) and the negative (-) lead to ground lug "X" (C) at XV8.

(✓) 13. Cut both leads on a 100K (brown, black, yellow, silver) resistor, R105, to 1". Cover each lead with a 3/4" piece of spaghetti. Connect from TB26-1 (C) to ground lug "X" (S2) at XV8.

(✓) 14. Connect a 6" piece of yellow wire from TB26-1 (C) to R106-3 (C).

(✓) 15. Connect a 7 1/2" piece of yellow wire from R106-3 (S2) to R107-3 (S1).

(✓) 16. Cut both leads on the silicon rectifier, CR1, to 1". Cover each lead with a 3/4" piece of spaghetti. Connect from TB9-1 (C) to TB9-2 (C), noting very carefully that the cathode lead (see introductory pages to the construction section for identification of cathode) is connected to TB9-2.

(✓) 17. Cut all leads on two 1.5K (brown, green, red, silver) resistors, R43 and R44, to 1/2". Connect R43 from XV3-3 (S1) to TB15-1 (C). Connect R44 from XV4-3 (S1) to TB16-1 (C).

(✓) 18. Connect an 8 1/2" piece of blue wire from TB15-2 (C) to TB9-1 (C).

(✓) 19. Connect a 12" piece of blue wire from R102-2 (C) to R80-2 (S1). Dress the lead along the chassis as shown.

(✓) 20. Connect a 6" piece of blue wire from R103-2 (C) to R79-2 (S1). Dress the lead along the chassis as shown.

(✓) 21. Cut all leads on two 50mfd, 50volt electrolytic capacitors, C39 and C40, to 1 1/4". Cover the negative (-) lead on each capacitor with a 3/4" piece of spaghetti. Connect the positive (+) lead of both capacitors to ground lug "V" (S2) being careful not to burn the leads running near the ground lug when soldering to it. Solder the negative (-) lead from C39 to R103-2 (S2) and the negative (-) lead from C40 to R102-2 (S2).

(✓) 22. Cut all leads on two 33K (orange, orange, orange, silver) resistors, R100 and R101, to 1/2". Connect R100 from R102-3 (S1) to ground lug "U" (S1) on C43. Connect R101 from R103-3 (S1) to ground lug "T" (S1) on XV7.

( ) 23. Cut both leads on a 68K (blue, grey, orange, silver) resistor, R98, to 1/2". Connect from R102-1 (S1) to TB15-2 (C).

( ) 24. Cut both leads on a 68K (blue, grey, orange, silver) resistor, R99, to 1". Cover each lead with a 3/4" piece of spaghetti. Connect from R103-1 (S1) to TB15-2 (S3).

( ) 25. Connect a 4" piece of black wire from TB24-2 (C) to TB10-1 (C).

( ) 26. Connect a 4 1/2" piece of black wire from TB15-1 (S4) to TB10-1 (C).

( ) 27. Connect a 6" piece of black wire from TB10-1 (C) to TB23-3 (C).

( ) 28. Connect a 1" piece of bare wire from TB23-3 (C) to TB8-1 (C).

( ) 29. Connect a 4" piece of black wire from TB8-1 (C) to TB16-1 (C).

( ) 30. Connect a 5" piece of black wire from TB16-1 (S5) to TB22-1 (C).

( ) 31. Connect a 4" piece of black wire from TB23-3 (C) to TB7-2 (C).

( ) 32. Connect a 6" piece of black wire from TB23-3 (C) to TB14-2 (C).

( ) 33. Connect a 3 1/2" piece of black wire from TB14-2 (C) to TB18 (C).

( ) 34. Connect a 3" piece of orange wire from XV1-8 (C) to TB23-4 (C).

( ) 35. Connect a 3" piece of orange wire from XV2-8 (C) to TB26-2 (C).

( ) 36. Cut all leads on two 1M (brown, black, green, silver) resistors, R11 and R12, to 1/2". Connect R11 from TB7-1 (C) to TB7-2 (C). Connect R12 from TB14-1 (C) to TB14-2 (C).

( ) 37. Cut all leads on two 22K (red, red, orange, silver) resistors, R13 and R14, to 5/8". Connect R13 from TB7-1 (S3) to XV1-7 (S1). Connect R14 from TB14-1 (S3) to XV2-7 (S1).

( ) 38. Cut all leads on two 200K (red, black, yellow, gold) resistors, R7 and R8, to 5/8". Connect R7 from TB19 (S3) to XV1-6 (C). Connect R8 from TB26-3 (C) to XV2-6 (C).

( ) 39. Cut all leads on two 68K (blue, grey, orange, gold) resistors, R27 and R28, to 1/2". Connect R27 from TB23-4 (S2) to XV1-3 (C). Connect R28 from TB26-2 (S2) to XV2-3 (C).

( ) 40. Cut both leads on a 1M (brown, black, green, silver) resistor, R104, to 3/4". Connect from TB26-1 (S4) to TB26-3 (C).

( ) 41. Cut all leads on two 2400 ohm (red, yellow, red, gold) resistors, R15 and R16, to 1/2". Connect R15 from XV1-8 (S3) to TB7-2 (S5). Connect R16 from XV2-8 (S3) to TB14-2 (S6).

( ) 42. Cut all leads on two 1200 ohms (brown, red, red, gold) resistors, R21 and R22 to 1/2". Connect R21 from XV1-3 (S2) to TB23-3 (C). Connect R22 from XV2-3 (S2) to TB18 (C).

( ) 43. Cut all leads on two 1.5M (brown, green, green, silver) resistors, R17 and R18, to 1/2". Connect R17 from XV1-2 (C) to TB23-3 (S6). Con- Connect R18 from XV2-2 (C) to TB18 (S3).

( ) 44. Cut both leads on a 40K (yellow, black, orange, gold) resistor, R19, to 1/2". Connect from XV1-1 (C) to TB23-2 (S2).

( ) 45. Cut one lead on a 40K (yellow black, orange, gold) resistor, R20 to 1 1/2" and cover it with a 1 1/4" piece of spaghetti. Cut the other lead to 3/4". Connect the spaghetti covered lead to C42-C (S5) and remaining lead to XV2-1 (C).

( ) 46. Cut all leads on four .025mfd (25K or 25,000 mmf) disc capacitors, C7, C8, C9 and C10, to 5/8". Connect C7 from XV1-2 (S2) to XV1-6 (S2). Connect C8 from XV2-2 (S2) to XV2-6 (S2). Connect C9 from XV1-1 (S2) to TB23-1 (S2). Connect C10 from XV2-1 (S2) to TB14-3 (S2). Bend all the capacitors down so that they are nearly parallel to the chassis. Note that none of the capacitor leads inadvertantly short against other leads or solder pins.

47. Cut all leads on two 1K (brown, black, red, silver) resistors, R87 and R88, to 5/8". Connect R87 from XV3-8 (C) to TB10-1 (C). Connect R88 from XV4-8 (C) to TB8-1 (C).

48. Cut all leads on two .015mfd (15K or 15,000 mmf) disc capacitors, C31 and C32, to 3/4". Connect C31 from XV3-8 (S2) to TB10-1 (C). Connect C32 from XV4-8 (S2) to TB8-1 (C).

49. Cut all leads on two 470K (yellow, violet, yellow, silver) resistors, R49 and R50, to 3/4". Connect R49 from XV3-7 (S2) to TB10-1 (S6). Connect R50 from XV4-7 (S2) to TB8-1 (S5).

50. Cut all leads on two 33K (orange, orange, orange, gold) 1/2 watt resistors, R37 and R38, to 1/2". Connect R37 from XV3-1 (C) to TB10-2 (C). Connect R38 from XV4-1 (C) to TB8-2 (C).

51. On one end of two 33K (orange, orange, orange, gold) 1/2 watt resistors, R39 and R40, cut the leads to 1/2". Connect the 1/2" end of R39 to TB10-2 (S3) and the 1/2" end of R40 to TB8-2 (S4). Cut the remaining ends of both resistors to 1 1/4" and cover each lead with a 1" piece of spaghetti. Connect this end of R39 to XV3-6 (C) and this end of R40 to XV4-6 (C).

52. Cut all leads on four .1mfd (brown, black, yellow, white, yellow) molded capacitors, C15, C16, C17 and C18 to 7/8". Cover each lead with a 5/8" piece of spaghetti. Connect C15 from TB16-3 (S3) to XV3-1 (S2). Connect C16 from TB16-2 (S3) to XV4-1 (S2). Connect C17 from TB6-2 (S2) to XV3-6 (S2). Connect C18 from TB6-1 (S2) to XV4-6 (S2).

53. Connect a 3 1/2" piece of blue wire from XV7-1 (C) to XV5-1 (C).

54. Connect a 3 1/2" piece of blue wire from XV6-1 (C) to XV5-6 (C).

55. Cut both leads on a 200K (red, black, yellow, gold) resistor, R53, to 1/2". Connect from XV5-1 (S2) to TB20 (C).

56. Cut both leads on a 200K (red, black, yellow, gold) resistor, R54, to 3/4". Cover one lead with a 1/2" piece of spaghetti and connect to XV5-6 (S2). Connect the other lead to TB20 (S3).

57. Cut all leads on two 470K (yellow, violet yellow, silver) resistors, R51 and R52, to 5/8". Connect R51 from XV5-2 (S2) to TB24-2 (C). Connect R52 from XV5-7 (S2) to TB22-1 (C).

58. Cut all leads on two 25mfd, 6 volt electrolytic capacitors, C33 and C34, to 3/4". Connect the negative (-) lead from C33 to TB24-1 (C) and the positive (+) lead to XV5-3 (C). Connect the negative (-) lead from C34 to TB22-2 (C) and the positive (+) lead to XV5-8 (C).

59. Cut all leads on two 1K (brown, black, red, silver) resistors, R55 and R56, to 3/4". Connect R55 from XV5-3 (S2) to TB24-1 (C). Connect R56 from XV5-8 (S2) to TB22-2 (C).

60. Cut all leads on two 100 ohm (brown, black, brown, gold) resistors, R57 and R58 to 1/2". Connect R57 from TB24-2 (S3) to TB24-1 (C). Connect R58 from TB22-1 (S3) to TB22-2 (C).

61. Connect a 10" piece of orange wire from TB22-2 (S4) to TB4-2 (S3).

62. Connect a 9 1/2" piece of orange wire fro... TB24-1 (S4) to TB5-2 (S4).

63. Connect a 1 1/8" piece of bare wire from XV7-3 (S1) to XV7-6 (C).

64. Connect a 1 1/8" piece of bare wire from XV6-3 (S1) to XV6-6 (C).

65. Cut all leads on two 1M (brown, black, green, silver) resistors, R59 and R60, to 1/2". Connect R59 from XV7-1 (S2) to XV7-4 (C). Connect R60 from XV6-1 (S2) to XV6-4 (C).

66. Cut all leads on two 28.75K, 1 watt resistors R61 and R62, to 1/2". Connect R61 from XV7-1 (C) to TB15-3 (S2). Connect R62 from XV6-2 (C) to TB21 (S3).

67. Cut all leads on two 18K (brown, grey, orange, gold) 1 watt resistors, R65 and R66, to 1/2". Connect R65 from XV7-6 (S2) to TB24-1 (S1). Connect R66 from XV6-6 (S2) to ground lug "S" (S1) at C42.

and run them along the chassis as shown. Connect the other end of the yellow wire to XV5-4 (C) and the other end of the brown wire to XV5-9 (S1).

( ) 22. Connect a 1/2" piece of bare wire from XV5-4 (S2) to XV5-5 (S1).

( ) 23. Connect one end of a 5" piece of brown wire to XV7-8 (S3) and one end of a 6 1/2" piece of yellow wire to XV7-7 (S3). Twist the leads together and run them along the chassis as shown. Connect the other end of the brown wire to XV9-7 (C) and the other end of the yellow wire to XV9-2 (C).

( ) 24. Connect one end of a 4" piece of yellow wire to XV9-2 (C) and one end of a 4" piece of brown wire to XV9-7 (C). Twist the leads together and run them along the chassis as shown. Connect the other end of the yellow wire to XV11-7 (S2) and the other end of the brown wire to XV11-2 (C).

( ) 25. Connect a 2" piece of yellow wire from XV9-2 (C) to R107-1 (S1).

( ) 26. Connect a 3" piece of brown wire from XV11-2 (S3) to R107-2 (S1). Be careful that R107-2 does not short to the pot mounting screw.

( ) 27. Connect a 1/2" piece of bare wire from XV4-4 (S1) to XV4-5 (C).

( ) 28. Connect one end of a 4" piece of brown wire to XV4-5 (S2) and one end of a 3" piece of yellow wire to XV4-9 (S1). Twist the leads together and run them along the chassis as shown. Connect the other end of the brown wire to XV6-8 (C) and the other end of the yellow wire to XV6-7 (C).

( ) 29. Connect one end of a 5" piece of brown wire to XV6-8 (S2) and one end of a 6 1/2" piece of yellow wire to XV6-7 (S2). Twist the leads together and run them along the chassis as shown. Connect the other end of the brown lead to XV8-7 (C) and the other end of the yellow lead to XV8-2 (C).

( ) 30. Connect one end of a 5" piece of brown wire to XV8-7 (C) and one end of a 5 1/2" piece of yellow wire to XV8-2 (C). Twist the leads together and run them along the chassis as shown. Connect the other end of the yellow wire to XV2-9 (S1) and the other end of the brown wire to XV2-4 (C).

( ) 31. Connect a 1/2" piece of bare wire from XV2-4 (S2) to XV2-5 (S1).

( ) 32. Connect one end of a 4" piece of yellow wire to XV8-2 (C) and one end of a 4" piece of brown wire to XV8-7 (S3). Twist the leads together and run them along the chassis as shown. Connect the other end of the yellow wire to XV10-7 (C) and the other end of the brown wire to XV10-2 (C).

( ) 33. Connect a 2" piece of yellow wire from XV8-2 (S4) to R106-1 (S1).

( ) 34. Connect a 3" piece of brown wire from XV10-2 (C) to R106-2 (S1). Be careful that R106-2 does not short to the pot mounting screw.

( ) 35. Connect a 3 1/2" piece of red wire from C43-A (C) to XV12-8 (C).

( ) 36. Cut both leads on 1800 ohm 5 watt resistor, R96, to 1". Connect from C43-A (S2) to C43-B (C). Dress this resistor away from all wires, but against the chassis.

( ) 37. Connect a 6" piece of red wire from C43-B (S2) to XV11-4 (C).

( ) 38. Connect an 11" piece of red wire from XV12-8 (C) to TB25-1 (C). Run the wire along the chassis as shown.

( ) 39. Connect a 1 1/4" piece of bare wire from XV11-4 (S2) to XV11-8 (C).

( ) 40. Connect a 3" piece of red wire from XV11-8 (S2) to XV9-8 (C).

( ) 41. Connect a 2 1/2" piece of red wire from XV9-4 (C) to XV10-4 (C).

( ) 42. Connect a 3" piece of red wire from XV10-8 (C) to XV8-8 (C).

( ) 43. Connect a 1 1/4" piece of bare wire from XV9-8 (S2) to XV9-4 (S2).

( ) 44. Connect a 1 1/4" piece of bare wire from XV10-4 (S2) to XV10-8 (S2).

( ) 45. Connect a 1 1/4" piece of bare wire from XV8-8 (C) to XV8-4 (S1).

( ) 46. Connect an 8" piece of red wire from TB25-2 (C) to C42-C (C).

The following steps refer to figure 11.

( ) 1. Cut all leads on four 100K (brown, black, yellow, gold) resistors, R75, R76, R77 and R78, to 1/2". Connect R75 from ground lug "R" (S1) at XV11 to R79-3 (C). Connect R76 from ground lug "Q" (S1) at XV10 to R80-3 (C). Connect R77 from ground lug "P" (S1) at XV9 to R79-1 (C). Connect R78 from ground lug "O" (S1) at XV8 to R80-1 (C).

( ) 2. Cut all leads on four 150K (brown, green, yellow, silver) resistors, R67, R68, R69 and R70, to 1/2". Connect R67 from R79-3 (S2) to XV11-1 (C). Connect R68 from R80-3 (S2) to XV10-1 (C). Connect R69 from R79-1 (S2) to XV9-1 (C). Connect R70 from R80-1 (S2) to XV8-1 (C).

( ) 3. Cut all leads on four 4.7K (yellow, violet, red, silver) resistors, R71, R72, R73 and R74, to 1/2". Connect R71 from XV11-6 (S1) to XV11-1 (C). Connect R73 from XV9-6 (S1) to XV9-1 (C). Connect R72 from XV10-6 (S1) to XV10-1 (C). Connect R74 from XV8-6 (S1) to XV8-1 (C).

( ) 4. Cut both leads on a 33K (orange, orange, orange, gold) 1 watt resistor, R63, to 1/2". Connect from XV7-5 (C) to TB17 (S3).

( ) 5. Cut one lead on a .1mfd (brown, black, yellow, white, yellow) molded capacitor, C19, to 1 3/4". Cover it with a 1 1/2" piece of spaghetti and connect it to XV11-1 (S3). Cut the remaining lead to 3/4" and connect it to XV7-2 (S2).

( ) 6. Cut one lead on a .1mfd (brown, black, yellow, white, yellow) molded capacitor, C22, to 1 1/4". Cover it with a 1" piece of spaghetti and connect it to XV8-1 (S3). Cut the remaining lead to 3/4" and connect it to XV6-5 (C).

( ) 7. Cut all leads on two .1mfd (brown, black, yellow, white, yellow) molded capacitors, C20 and C21, to 1 1/4". Cover each lead with a 1" piece of spaghetti. Connect C20 from XV6-2 (S2) to XV10-1 (S3). Connect C21 from XV7-5 (S2) to XV9-1 (S3).

( ) 8. Cut both leads on a 33K (orange, orange, orange, gold) 1 watt resistor, R64, to 3/4". Connect from XV6-5 (S2) to C42-A (S4).

( ) 9. Connect a 2 1/2" piece of orange wire from J19 (C) to XV11-5 (S1).

( ) 10. Connect a 2 1/2" piece of orange wire from J21 (S1) to XV9-5 (C).

( ) 11. Connect a 2 1/2" piece of orange wire from J20 (S1) to XV10-5 (C).

( ) 12. Connect a 2 1/2" piece of orange wire from J18 (C) to XV8-5 (S1).

( ) 13. Cut one lead on each of two .25mfd (red, green, yellow, white, yellow) 400 volt molded capacitors, C37 and C38, to 1" and cover each of these leads with a 3/4" piece of spaghetti. Cut the remaining lead on each of the capacitors to 2" and cover them with 1 3/4" pieces of spaghetti. Connect the longer lead of C37 to XV7-4 (S2) and the shorter lead to ground lug N (S1) at XV12. Connect the longer lead of C38 to XV6-4 (S2) and the shorter lead to ground lug "M" (S1) on XV9.

The following steps refer to figure 2.

( ) 14. On power transformer T3, cut both green leads to 6 1/2", both brown leads to 8 1/2", both yellow leads to 8", both red leads to 7", both black leads to 5", the white lead to 5" and the red-yellow lead to 4". Strip the insulation back 1/4" from the ends of each of the leads. Mount the power transformer through the rectangular cut-out, so that the black and yellow leads are nearest the edge of the chassis. Secure the transformer to the chassis using four #8 lockwashers and four #8-32 hex nuts. Under each of two of the lockwashers, place a #8 ground lug, as shown.

( ) 15. On output transformer T1, cut the orange lead to 4 1/2", the green lead to 5", the black lead to 4", the yellow lead to 4", the blue lead to 9", the brown lead to 4 1/2" and the red lead to 3". Strip the insulation back 1/4" from the ends of each of the leads. Mount the transformer noting the lead breakout and orientation in Figure 11.

Push the brown, blue and red leads through hole "D" and all the remaining leads through hole "E".

To secure the transformer to the chassis, use four #8 lockwashers and four #8-32 hex nuts. Under one lockwasher place a metal cable clamp. Run the yellow, black, orange and green leads under this clamp.

16. On output transformer T2, cut the orange lead to 5", cut the green lead to 5 1/2", cut the black lead to 5", cut the yellow lead to 4 1/2", cut the red lead to 5", cut the brown lead to 4 1/2" and cut the blue lead to 9". Strip the insulation back 1/4" from the ends of each of the leads. Mount the transformer noting the lead breakout and orientation in Figure 10. Push the brown, blue and red leads through hole "C" and all the remaining leads through hole "B". To secure the transformer to the chassis, use four #8 lockwashers and four #8-32 hex nuts. Under one lockwasher, place a metal cable clamp. Run the yellow, black, orange and green leads under this clamp. Place one #8 ground lug under each of two of the remaining lockwashers.

17. From power transformer T3, connect one black lead to XF1-2 (S1) and the second black lead to J17-2 (C). Connect the white and red-yellow leads to ground lug "W" (C). Connect one red lead to XV12-4 (S1) and the second red lead to XV12-6 (S1). Connect one yellow lead to XV12-2 (S1) and the second yellow lead to XV12-8 (S3). Connect one green lead to XV9-7 (S3) and the second green lead to XV9-2 (S4). Connect one brown lead to XV10-7 (S2) and the second brown lead to XV10-2 (S3). Connect the blue lead to TB9-2 (S2). CAUTION: Excess heat on the leads of the rectifier can ruin it. While soldering to TB9-2, place a pair of long nose pliers on the lead between the heat away from the iron so that the heat will not reach the rectifier.

18. From output transformer T1, hole "E", connect the green lead to TB1-4 (S3), the orange lead to TB1-3 (S1), the black lead to TB1-2 (S1) and the yellow lead to TB1-1 (S2).

19. From output transformer T1, hole "D", connect the red lead to TB25-1 (C), the brown lead to XV9-3 (S1) and the blue lead to XV11-3 (S1).

20. From output transformer T2, hole "B", connect the green lead to TB3-4 (C), the orange lead to TB3-3 (S1), the black lead to TB3-2 (S2) and the yellow lead to TB3-1 (S2).

21. From output transformer T2, hole "C", connect the red lead to TB25-1 (S4), the brown lead to XV8-3 (S1) and the blue lead to XV10-3 (S1).

22. Cut both leads on a .03mfd (orange, black, orange, black, blue) molded capacitor, C47, to 1". Connect from J17-2 (S3) to ground lug "I" (S1).

23. Cut both leads on a 16Ω 20 watt resistor, R90, to 1". Connect from TB3-4 (S5) to TB25-4 (S2). Dress the resistor away from all leads, but flat on the chassis.

24. On the 30mfd, 400 volt electrolytic capacitor, C44, cut both leads to 1 1/2". Connect the positive (+) lead to TB25-3 (S3) and the negative (-) lead to ground lug "Y" (C).

25. On the 16mfd, 350 volt electrolytic capacitor, C45, cut both leads to 1 1/4". Connect the positive (+) lead to TB26-3 (S4) and the negative (-) lead to ground lug "Y" (S2).

26. Cut all leads on four 10Ω, 1 watt, 1% resistors, R81, R82, R83 and R84, to 1/2". Connect R81 from J19 (S2) to ground lug "W" (C). Connect R83 from XV9-5 (S2) to ground lug "L" (S1) at XV10. Connect R84 from XV10-5 (S2) to ground lug "K" at XV9. Connect R82 from J18 (S2) to ground lug "J" (S1).

27. Cut both leads on a 50mfd, 150 volt electrolytic capacitor, C41, to 3/4". Connect the negative (-) lead to TB9-1 (S3) and the positive (+) lead to ground lug "W" (S4). CAUTION: Excess heat on the leads of the rectifier can ruin it. While soldering to TB9-1, place a pair of long nose pliers on the lead between the junction to be soldered and the rectifier to conduct the heat away from the iron so that the heat will not reach the rectifier.

28. Push the line cord through the grommet at the rear of the chassis, below the fuseholder. Tie a knot inside the chassis, 3" from the solder terminals of the wire. Connect one lead to J16-1 (S3) and the second lead to J16-2 (S2).

FINAL STEPS

You have now completed the assembly and wiring of your amplifier. When you have completed the following steps your amplifier will be ready for use.

( ) 1. To catch any wiring errors, it is suggested that the entire wiring be checked point-by-point against the wiring instructions, and preferably also against the schematic wiring diagram in order to become more familiar with the component layout and circuitry. While doing so, check for rosin joints, loose lumps of solder, poor lead dress, and accidental shorts or leakage paths arising from the flow of rosin between contacts. Remove excess rosin with a stiff brush dipped in carbon tetrachloride, being careful not to inhale fumes or to contact the carbon tetrachloride with your skin.

( ) 2. Insert tubes V1 through V12 in their sockets. Be sure to insert the correct tube in each socket. Place a shield over tubes V1, V2, V3, V4 and V5. See the tube layout in the Instruction Book. Insert fuse F1 in the fuseholder. DO NOT PLUG CORD INTO POWER LINE. Put the AC power switch on the treble control to the ON position.

( ) 3. If you have a VTVM or VOM, make the following resistance checks before connecting to the a-c line: Check for a cold d-c resistance of at least 1/2 ohm across the a-c line plug. Check for a resistance of at least 25,000 ohms between ground and pin 8 of XV12. Allow sufficient time for the electrolytic capacitors to be charged by the ohmmeter battery in this measurement. These measurements constitute a reasonable check of the power supply components and wiring before applying power. If you do not obtain the minimum resistance values indicated, do not proceed to the next step until the cause is discovered and the condition remedied.

The following steps refer to Figures 12a & 12b.

( ) 4. In the drawing, the chassis is shown mounted on two side rails. One surface of each side rail has nine decorative grooves while the opposite surface has two flanges. One flange runs along the center. In each case, the decorative grooves are on the outside, while the chassis is mounted onto the flanges. The chassis is mounted on the flanges which run along the center of the sic rails. The remaining flanges will be at the bot tom of the unit eventually used to hold the botto plate. The flat surface of the rails, without th flanges, will protrude above the chassis. The hoc

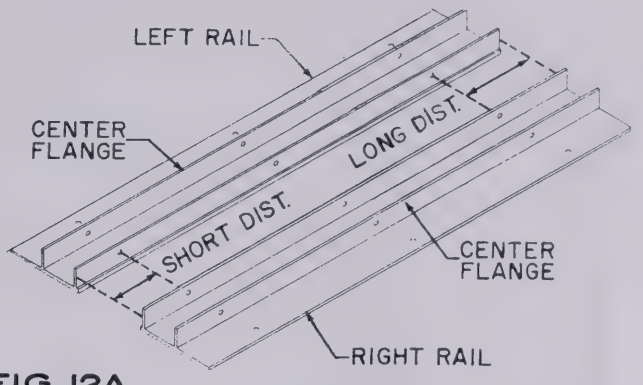


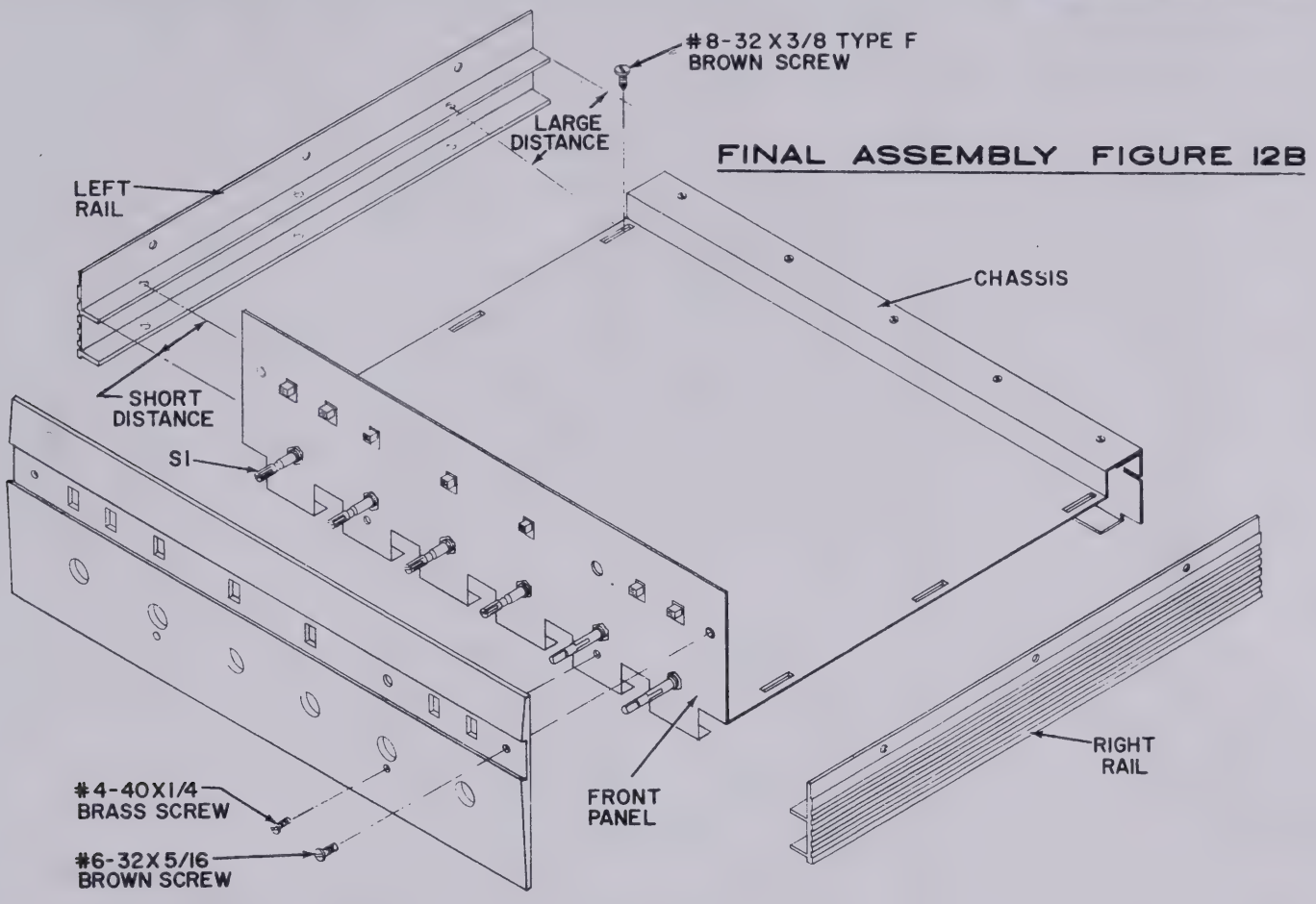
FIG. 12A

will later be mounted to these flat surfaces c both rails.

It should be noted that the two side rails a different. Hold the rails so that the two flang running along the edge are near each other, shown in Figure 12a. Note that there are thre screw holes in each flange. The holes are near one edge of the rail (marked short distance) thc to the second edge (marked large distance). you lay these rails on the table so that the "shc distance" is nearer to you, as shown, the rail your left is the "left rail".

Place the center flange of the left rail und the edge of the chassis nearest the four waf rotary switch, S1. Slide the rail through th groove in the rear panel. The "short distance is so oriented that it is towards the front of th chassis. Note that the flat surface on the ra protrudes above the chassis. Secure the rail the chassis through the rectangular slots in th chassis. Use three 8-32 x 3/8 Type F brown se tapping screws to secure the rail to the chassi Insert the self tapping screws through the rectar gular chassis cut-outs into the screw holes in th center flange of the rail. Push the rail as far it will go to the front of the chassis. Do n tighten these screws firmly at this time.

Similarly, mount the remaining edge of th chassis onto the center flange of the right rai The "short distance" is so oriented that it is towa the front of the chassis. Note that the flat surfac on the rail protrudes above the chassis. Secu the rail to the chassis through the rectangular slc in the chassis. Use three 8-32 x 3/8 Type F brov



FINAL ASSEMBLY FIGURE 12B

self tapping screws to secure the rail to the chassis. Push the rail as far as it will go to the front of the chassis. Do not tighten these screws firmly yet.

( ) 5. At the rear of the front panel place a piece of scotch tape over the small hole used for mounting the jewel. Cut a small portion of the stem on the glue capsule with a scissors. Apply a drop of glue on the base of the jewel and press it into the hole.

( ) 6. Mount the panel to the front apron of the chassis. Secure this panel to the front apron using two #6-32 x 5/16 Binding Head brown oxide screws at the two ends in the brown grooved section of the panel. Use one #4-40 x 1/4 brass screw under the shaft for the MODE control and a second #4-40 x 1/4 brass screw under the shaft for the BASS control. Do not tighten these screws too much or the threads will strip.

( ) 7. Loosen the six screws that hold both side rails to the chassis. Slide the rails forward until they are flush against the front panel. The side rails should be square with the front panel. Retighten these six screws. Do not tighten too much or the threads will strip.

The following steps refer to Figure 13.

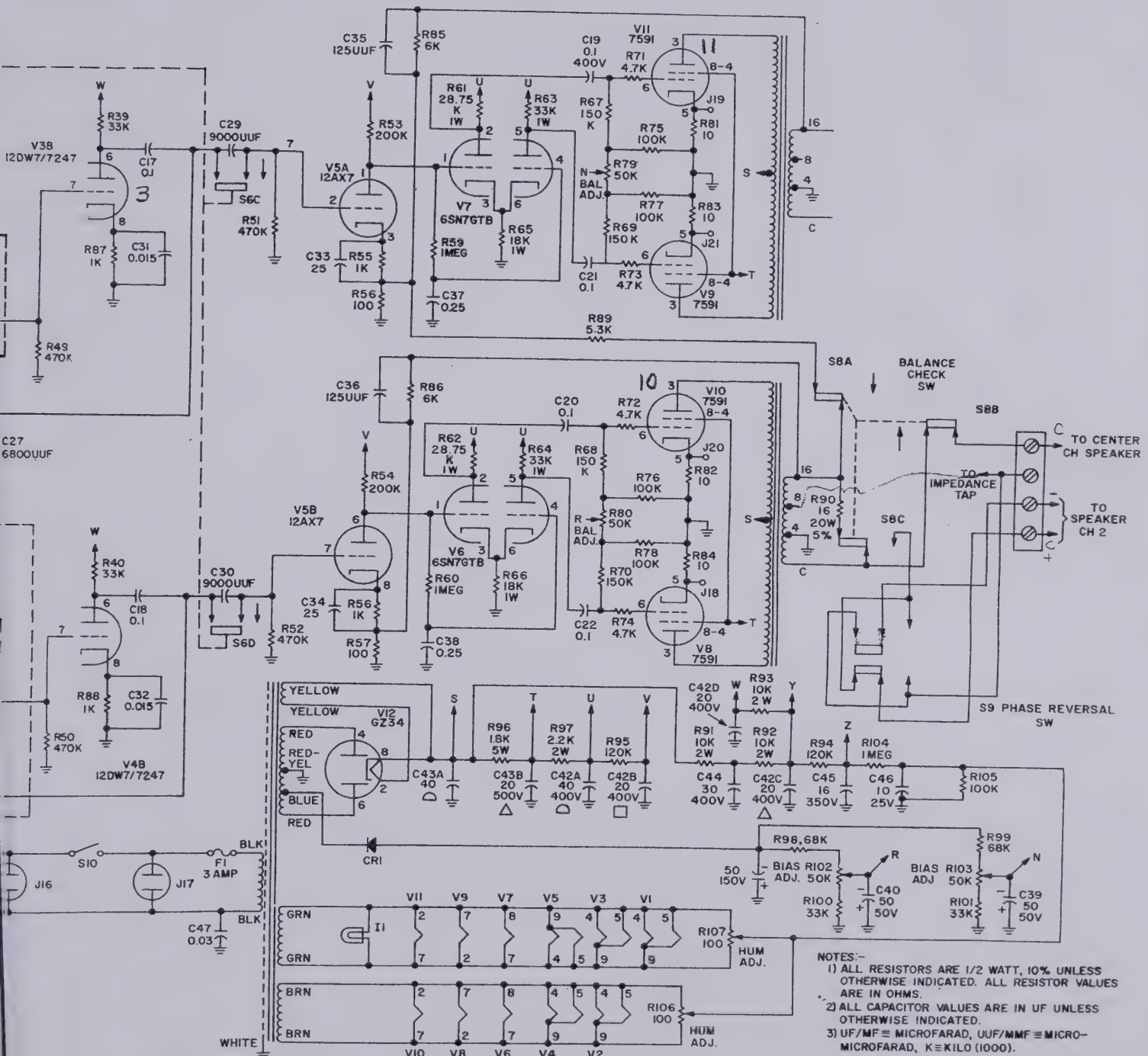
( ) 8. There is a bump in each of the four corners of the bottom plate. A plastic foot is to be mounted onto the raised portion of each bump. Push a 6-32 x 5/16 screw through each foot and secure each foot using one #6 lockwasher and one #6-32 hex nut.

( ) 9. Turn the unit over so that it rests on the front panel and transformers. Place a long block of wood or some books under the rear panel to raise the transformers off the workbench. When properly executed, the amplifier will rest on the front panel and on the block of wood — not on the transformers.

Secure the rear of the bottom plate firmly to the rear panel using three #8-32 self tapping screws.

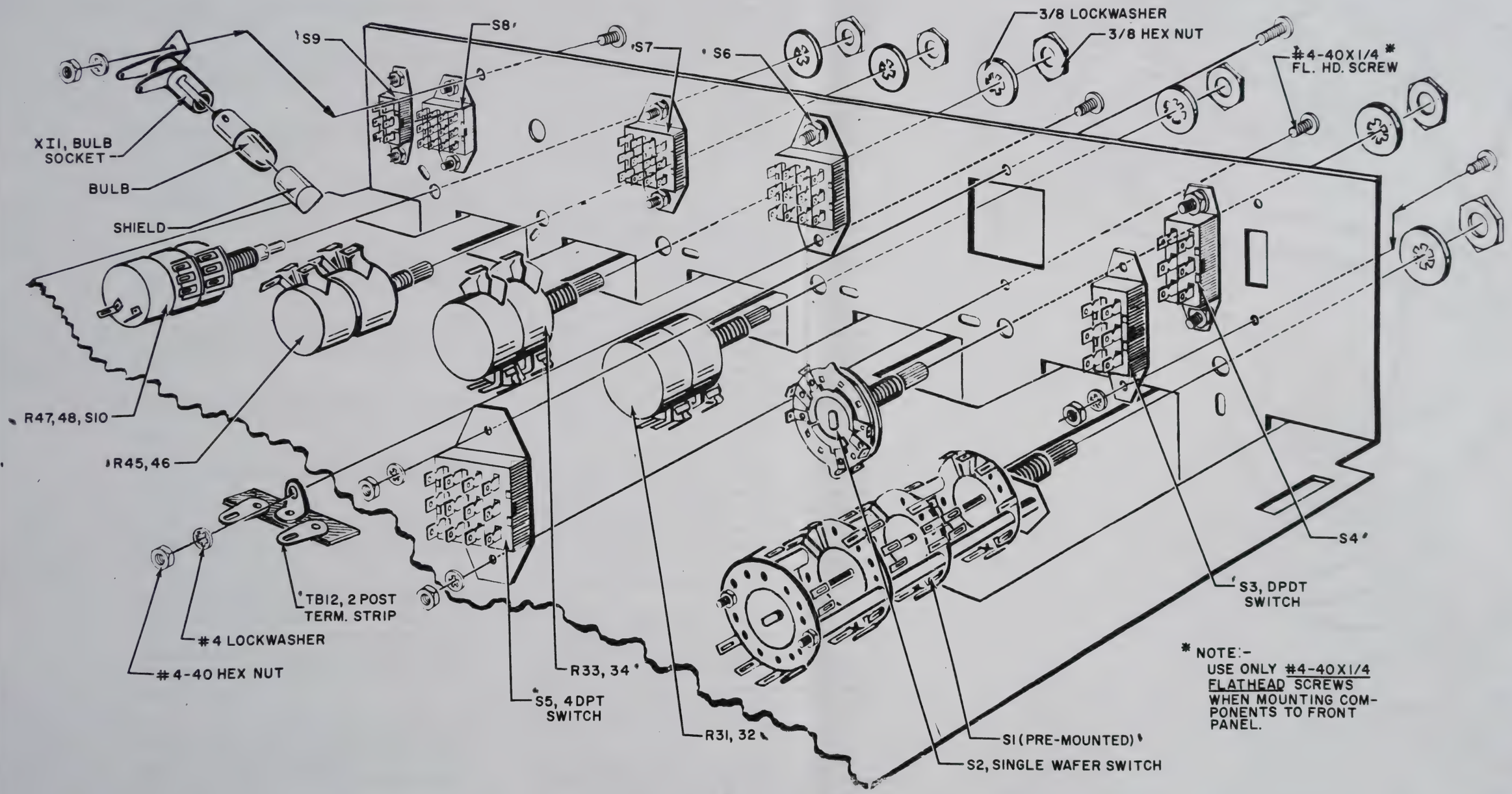
Next, hold the bottom plate to the front edge of the chassis with four #8-32 self tapping screws. Hold the bottom plate to the two side rails with six #8-32 x 3/8 Type F brown oxide self tapping

ST 70 – SCHEMATIC DIAGRAM



NOTES:-

1) ALL RESISTORS ARE 1/2 WATT, 10% UNLESS OTHERWISE INDICATED. ALL RESISTOR VALUES ARE IN OHMS.
2) ALL CAPACITOR VALUES ARE IN UF UNLESS OTHERWISE INDICATED.
3) UF/MF ≡ MICROFARAD, UUF/MMF ≡ MICRO-MICROFARAD, K≡KILO (1000).



FRONT PANEL ASSEMBLY FIGURE 6

Strip the insulation back 1/4" from each end of the inner conductor. Connect the inner conductor from the end without the shield strands to S1G-6 (S1). The other end will be connected later.

( ) 5. Connect a 3/4" piece of bare wire from S1D-11 (C) to S1E-11 (S1).

( ) 6. Connect a 1 1/2" piece of bare wire covered with a 1" piece of spaghetti from S1D-12 (S1) to S1D-1 (C).

( ) 7. Connect a 2 1/2" piece of blue wire from S1B-12 (S1) to S1B-3 (C).

( ) 8. Connect one end of a 4" piece of blue wire to S1D-8 (C). The other end will be connected later.

( ) 9. Connect one end of a 3 1/2" piece of green wire to S1D-7 (S1). The other end will be connected later.

( ) 10. Connect one end of a 4 1/2" piece of black wire to S1C-6 (C). The other end will be connected later.

( ) 11. Connect one end of a 5" piece of brown wire to S1E-9 (C). The other end will be connected later.

( ) 12. Connect one end of a 2 1/2" piece of orange wire to S1F-8 (S1). The other end will be connected later.

( ) 13. Connect one end of a 2" piece of black wire to S1H-1 (C). The other end will be connected later.

The five triple input jacks were previously mounted on the rear panel. The shielded wires were connected to these jacks. Place the panel near the switch S1, so that the jacks appear in the sequence shown in the drawing. See the mechanical layout of this in figure 3 and the wiring in figures 4 and 9.

( ) 14. From triple input jack J4, 5, 6 connect the shield strands from the remaining end of the shielded cable to S1H-11 (S3), the brown lead to S1H-8 (S1), the red lead to S1H-9 (S1) and the orange lead to S1H-10 (S1).

( ) 15. From triple input jack J10, 11, 12, connect the shield strands from the remaining end of the shielded cable to S1F-6 (C), the brown lead to S1E-9 (S2), the red lead to S1E-10 (S1) and the orange lead to S1F-12 (S1).

( ) 16. From the triple input jack J7, 8, 9, connect the shield strands from the remaining end of the shielded cable to S1C-6 (C), the brown lead to S1D-8 (S2), the red lead to S1D-9 (S1) and the orange lead to S1D-10 (S1).

( ) 17. On triple input jack J13, 14, 15, one end of a black shielded lead was connected to J13, 14, 15-4 and J13, 14, 15-5. Connect the shield strands from the other end to S1C-6 (C) and the inner conductor to S1D-11 (S2).

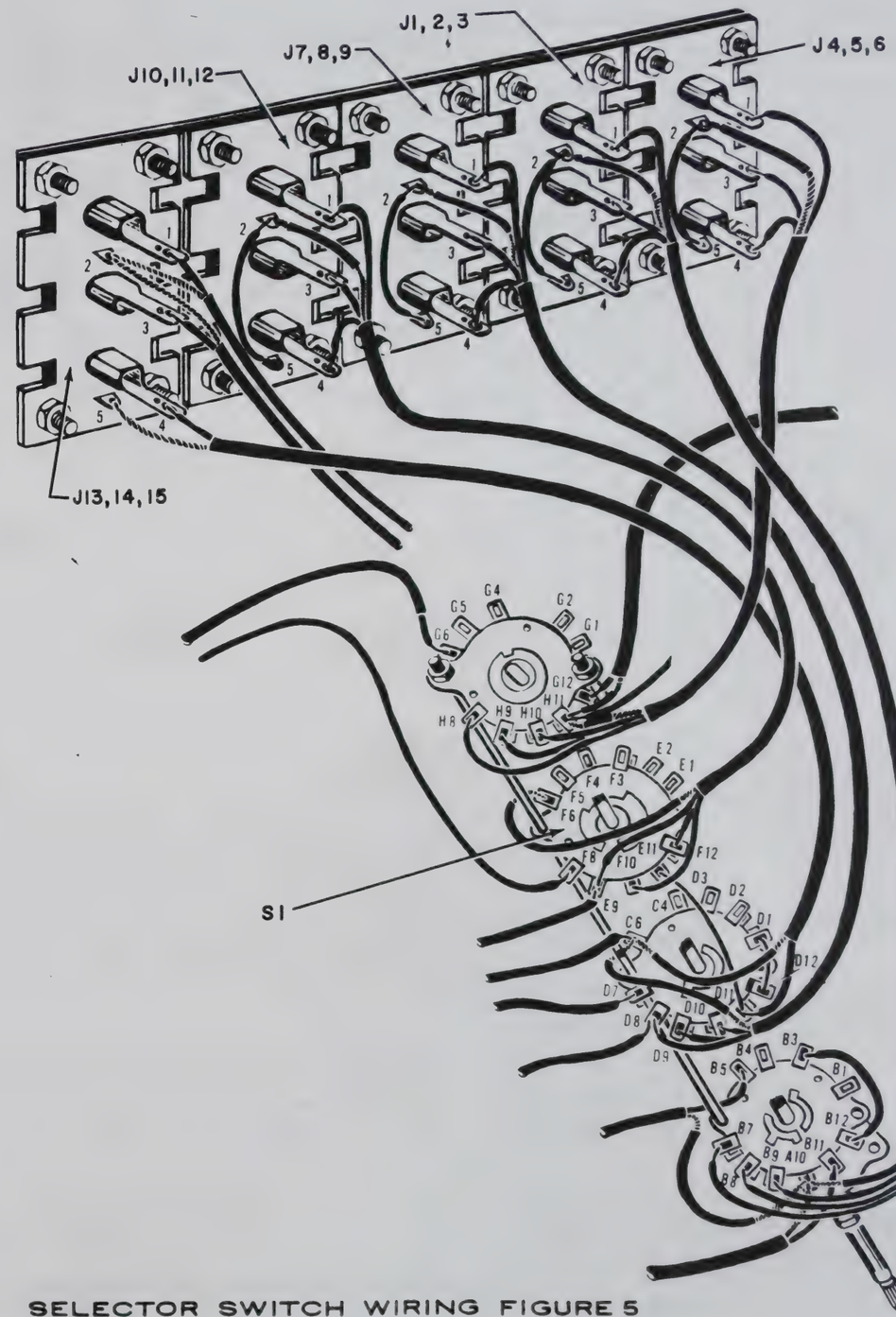
( ) 18. From the triple input jack J1, 2, 3, connect the shield strands from the remaining end of the shielded cable to S1A-10 (S3), the brown lead to S1B-7 (S1), the red lead to S1B-8 (S1) and the orange lead to S1B-9 (S1).

( ) 19. You have now completed the prewiring of the switch. Mount the rear panel to the rear protrusion on the main chassis using 5 #6 self tapping screws. See figures 2 & 9 for the orientation and mounting of the panel. Push the group of 8 twisted leads through hole "A" and the shield leads connected to J13, 14, 15-1 and J13, 14, 15-3 through hole "AA".

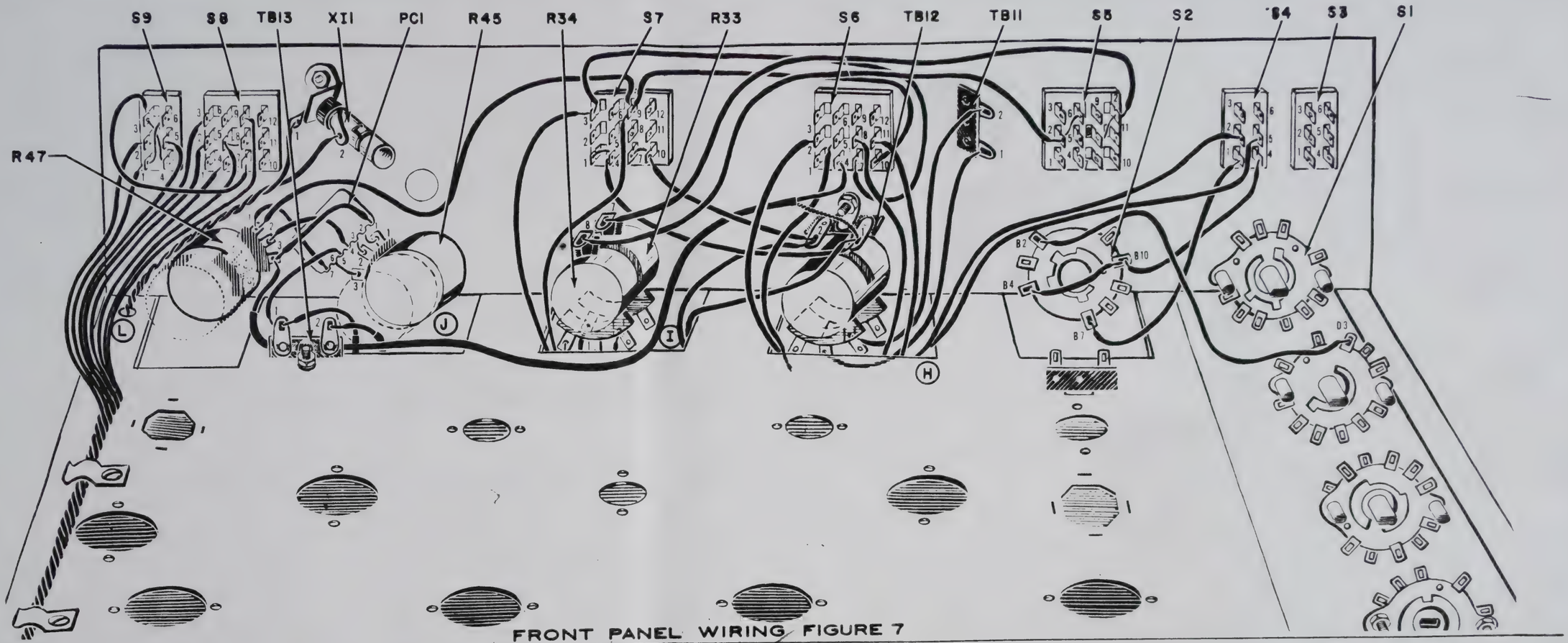
( ) 20. Mount the switch just prewired, S1, on to the front panel. Orient the switch so that the locating lug fits into the elliptical hole adjacent to the mounting hole. Use a 3/8" lockwasher as shown. Secure the control to the panel using a 3/8" hex nut. See figure 6 to note the mechanical mounting. See figure 9 for the placement of the leads from the rear input jacks.

( ) 21. Slip a plastic cable clamp around the wires connected to S1 and the input jacks. Position this clamp over the hole on the chassis near the input jacks. See figure 9 for location. Put a #6 flatwasher on a #6-32 x 5/16 screw and secure cable clamp to chassis with a #6 lockwasher and a #6 hex nut on the top side of the chassis.

( ) 22. Similar to above, slip a second plastic cable clamp over the leads and secure to the chassis in the hole near XV2. See figure 9. Use a #6-32 x 5/16 screw, #6 flatwasher, #6 lockwasher and a #6 hex nut.



SELECTOR SWITCH WIRING FIGURE 5



FRONT PANEL WIRING FIGURE 7

12. Connect a 3/4" piece of bare wire from S7-1 (C) to S7-4 (C).

13. Connect a 3/4" piece of bare wire from S7-7 (C) to S7-10 (C).

14. Connect a 3" piece of black wire from S7-10 (C) to TB12-2 (C).

15. Connect a 5" piece of black wire from S7-4 (C) to TB12-1 (C).

16. Connect one end of a 7" piece of grey wire to S7-3 (C) and one end of a 6" piece of blue wire to S7-9 (C). Run both leads along the panel, through rectangular hole "I" to the bottom side of the chassis.

17. Connect a 6" piece of blue wire from R47-1 (S2) to S7-9 (C).

18. Connect a 5" piece of blue wire from S7-9 (S3) to S6-10 (C).

19. Connect a 6" piece of grey wire from S7-3 (C) to S6-7 (C).

20. Connect a 7" piece of green wire from S5-12 (C) to R33-7 (S1).

21. Connect a 6 1/2" piece of green wire from S5-2 (C) to R34-8 (S1).

22. Connect one end of a 4" piece of orange wire to TB12-1 (C) and one end of a 3 1/2" piece of white wire to TB12-2 (C). Run both leads along the front panel as shown and push them through rectangular hole "I" to the bottom side of the chassis.

23. Connect one end of a 5" piece of green wire to S6-2 (C), one end of a 6" piece of white wire to S6-5 (C), one end of a 7" piece of blue wire to S6-8 (C) and one end of an 8" piece of yellow wire to S6-11 (C). Push the other end of all leads through hole "H" to the bottom side of the chassis.

24. Connect one end of a 3" piece of white wire to TB11-1 (C) and one end of a 4" piece of brown wire to TB11-2 (C). Push the other end of both leads through hole "H" to the bottom side of the chassis.

25. Connect a 3/4" piece of bare wire from S5-2 (S2) to S5-6 (S1).

26. Connect a 3/4" piece of bare wire from S5-8 (S1) to S5-12 (S2).

27. Connect a 2" piece of black wire from S2B-10 (C) to S2B-4 (C).

28. Connect a 3" piece of grey wire from S4-4 (S1) to S2B-10 (S2).

29. Connect a 3 1/2" piece of white wire from S4-1 (S1) to S2B-7 (C).

30. Connect a 4 1/2" piece of grey wire from S1D-3 (S1) and S2B-2 (C).

31. Connect one end of a 7" piece of grey wire to S4-5 (S1) and one end of a 6" piece of red wire to S4-2 (S1). Run both leads along the front panel as shown. Push them through hole "H" to the bottom of the chassis.

The following steps refer to figure 1.

Place the chassis on the workbench in the position shown in the drawing. The surface of the chassis facing up towards you will be referred to as the bottom, while the surface laying against the workbench is the top. The front of the chassis has the six rectangular cutouts while the rear of the chassis has only one rectangular cutout at the left corner. Orient each component as shown in Fig. 9 (fold-out).

( ) 1. Mount octal socket XV8 on the bottom near the right hand side of the chassis, as shown. Note the orientation of the center key in Fig. 9. Use two #6-32 x 5/16 screws, two #6 lockwashers and two #6-32 hex nuts.

( ) 2. Similar to the above, mount octal sockets XV6, XV7, XV9, XV10, XV11 and XV12. Note the orientation of the center keys in Figure 9. Use two #6-32 x 5/16 screws, two #6 lockwashers and two #6-32 hex nuts to secure each socket to the chassis. Under one of the lockwashers used on XV7, place the one post right terminal board TB17.

( ) 3. Mount the four 2 post terminal strips, TB6, TB7, TB9, TB10; the two 1 post right terminal strips, TB18 and TB19 the two 1 post left terminal strips, TB20 and TB21; the three 3 post 2 right terminal strips, TB14, TB15 and TB16; the 3 post 2 left terminal strip, TB26; the 3 post 2 left with ground terminal strip, TB23; the 2 post left with ground terminal strip, TB24; and the 4 post terminal strip, TB25; to the bottom of the chassis as shown. Observe the orientation of each terminal strip in Fig. 9. Use one #6-32 x 5/16 screw, one #6 lockwasher and one #6-32 hex nut to secure each terminal strip to the chassis.

( ) 4. Mount the four 50K snap-in pots, R79, R80, R102 and R103 in holes as shown. Note the orientation of each pot shown here and in fig. 9. Press each pot firmly towards the chassis until a click is heard and is held securely to the chassis.

( ) 5. Mount the miniature wire wound adjustment pots, R106 and R107, to the bottom of the chassis, as shown. Note the orientation of each pot in Fig. 9. Use two #4-40 x 5/16 screws from BELOW the chassis and two #4 lockwashers and two #4-40 hex nuts from ABOVE the chassis on each pot. Do not short the screws to the solder lugs on the pots.

The following steps refer to figure 2.

In this drawing, the chassis shown in Fig. 1 has been turned over. The top of the chassis is now up towards you, while the six rectangular cutouts and the front panel with other cutouts are away from you. The mounting of the rear panel is shown in the drawing, but will not be completed at this time. The transformer mountings are also shown in this drawing, but will be completed later.

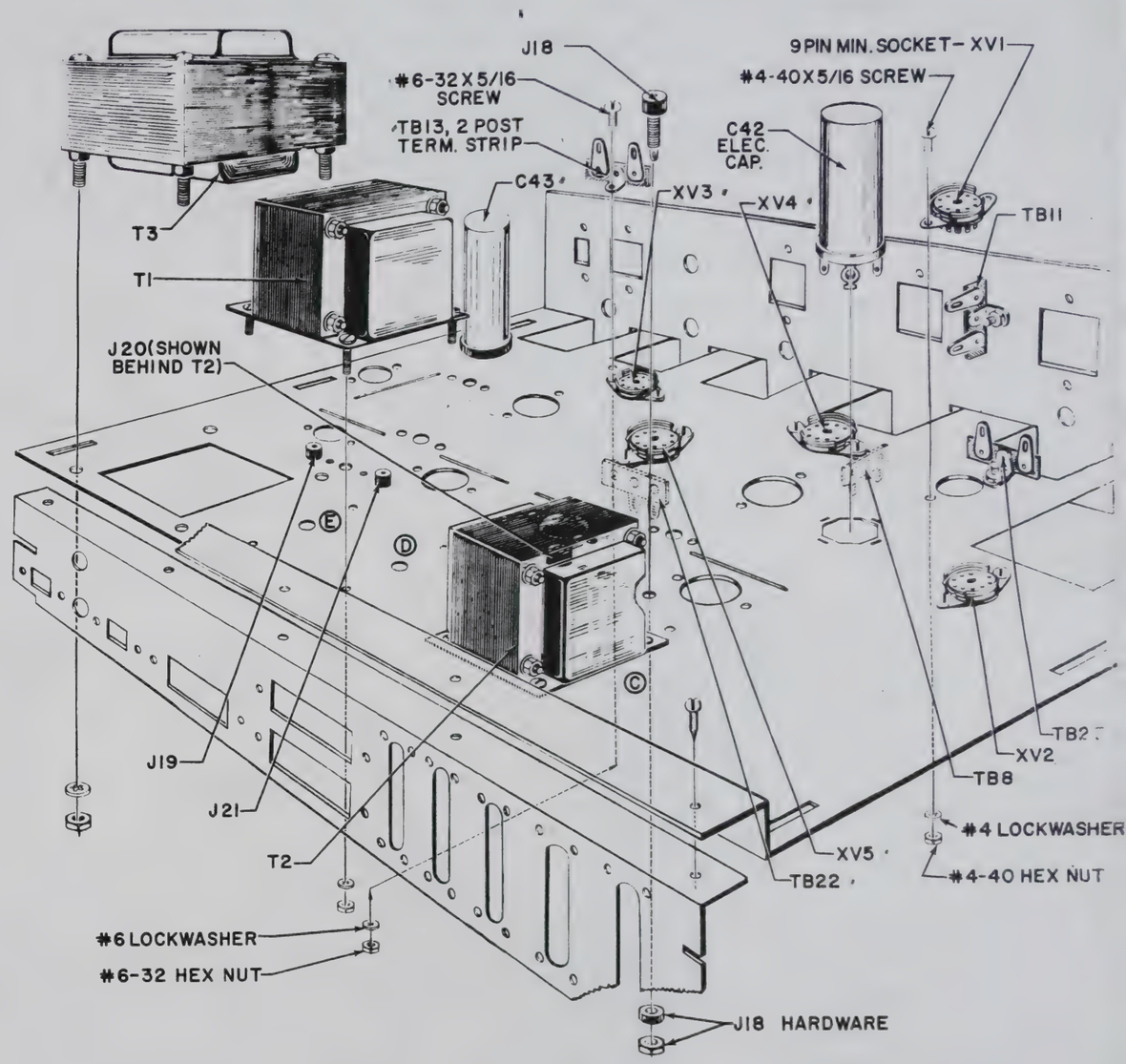
( ) 1. Mount the two 2 post terminal strips, TB27 and TB13. Use one #6-32 x 5/16 screw, one #6 lockwasher and one #6-32 hex nut to secure each terminal strip to the chassis.

( ) 2. Mount the 2 post terminal strip TB11, to the front panel on the chassis using a #4-40 x 1/4 flat head screw, one #4 lockwasher and one #4-40 hex nut.

( ) 3. Mount the five 9 pin miniature sockets with shield support, XV1, XV2, XV3, XV4 and XV5 from above the chassis, as shown. Noting the pin numbers stamped next to each solder lug in the mold, orient the sockets as shown in Fig. 9. Secure each socket to the top of the chassis using two #4-40 x 5/16 screws, two #4 lockwashers and two #4-40 hex nuts. Under one lockwasher used for XV5, place the 2 post right terminal strip TB22 and under one lockwasher used for XV4 place the 2 post terminal strip TB8.

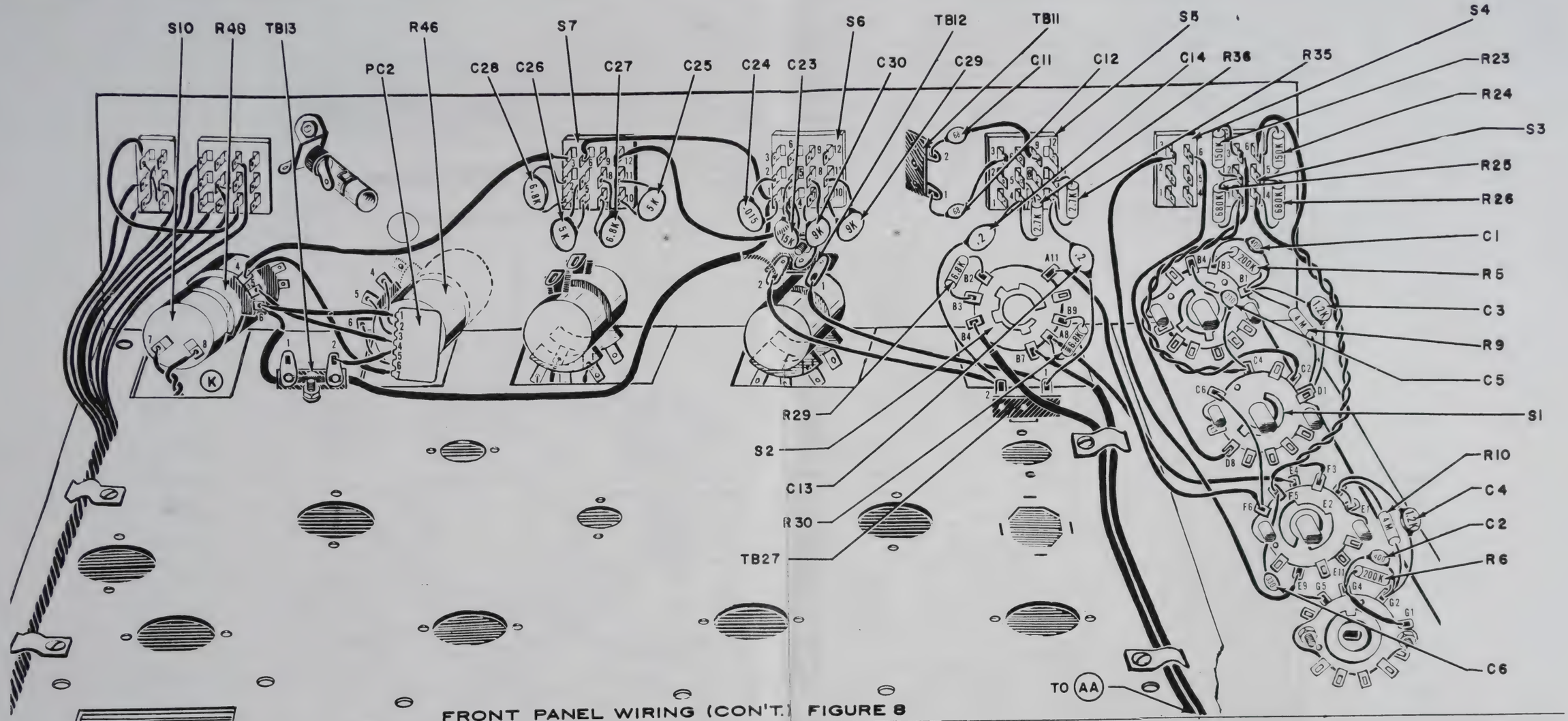
( ) 4. Mount the 40/20mfd, 500V electrolytic can capacitor, C43, to the top of the chassis as shown. Next to one lug is a triangle and next to the second lug is a semicircle. Orient the capacitor so that the triangle and semicircle appear at the respective locations as shown in Fig. 9. Insert the capacitor mounting tabs into the slots in the chassis and twist the tabs a little less than a quarter turn. Do not twist the tabs excessively or they will shear off. Solder the capacitor tab without a hole, to the chassis at the slot in the chassis.

( ) 5. Mount the 40/20/20/20mfd, 450V electrolytic can capacitor, C42, to the top of the chassis as shown. Next to one lug is a half moon (semicircle), next to a second lug is a square and next to a third lug is a triangle. Orient the capacitor and secure as in previous step.



TOP CHASSIS ASSEMBLY FIGURE 2

( ) 6. Mount the four meter pin jacks, J18, J19, J20, and J21 with the hardware supplied on the jacks. Remove the nut and the fibre washer from the threaded portion of each jack. Pass the threaded portion of each jack through their respective holes in the chassis. Secure each jack with its fibre washer and hex nut inside of the chassis. The small shoulder on the fibre washer should seat in the mounting holes. If the assembly is properly completed, each jack will be insulated from the chassis.



FRONT PANEL WIRING (CON'T.) FIGURE 8

The following steps refer to figure 8.

( ) 1. Connect one end of a 15" piece of black wire to S10-7 (S1) and one end of a 17" piece of black wire to S10-8 (S1). Twist the leads together and push them through the rectangular hole "K" to the bottom side of the chassis.

( ) 2. Cut all leads on two .0068mfd (6.8K or 6,800 mmf) disc capacitors, C27 and C28, to 1/2". Connect C27 from S7-8 (S1) to S7-7 (S2). Connect C28 from S7-2 (S1) to S7-1 (S2).

( ) 3. Cut all leads on two .005mfd (5K or 5000mmf) disc capacitors, C25 and C26, to 1/2". Connect C25 from S7-11 (S1) to S7-10 (S3). Connect C26 from S7-5 (S1) to S7-4 (S3).

( ) 4. On one end of an 8" piece of black single conductor shielded cable, strip the outer insulation back 1/2". Twist the shield strands together and cut them off. Strip back 1/4" of the insulation from the inner conductor and connect it to R48-6 (C).

On the other end of the same cable strip the outer insulation back 3/4". Twist the shield strands together. Strip back 1/4" of the insulation from the inner conductor and connect it to S6-1 (C). Connect the twisted shield strands to TB12-2 (C).

( ) 5. Connect a 6" piece of grey wire from R48-4 (C) to S7-3 (S3).

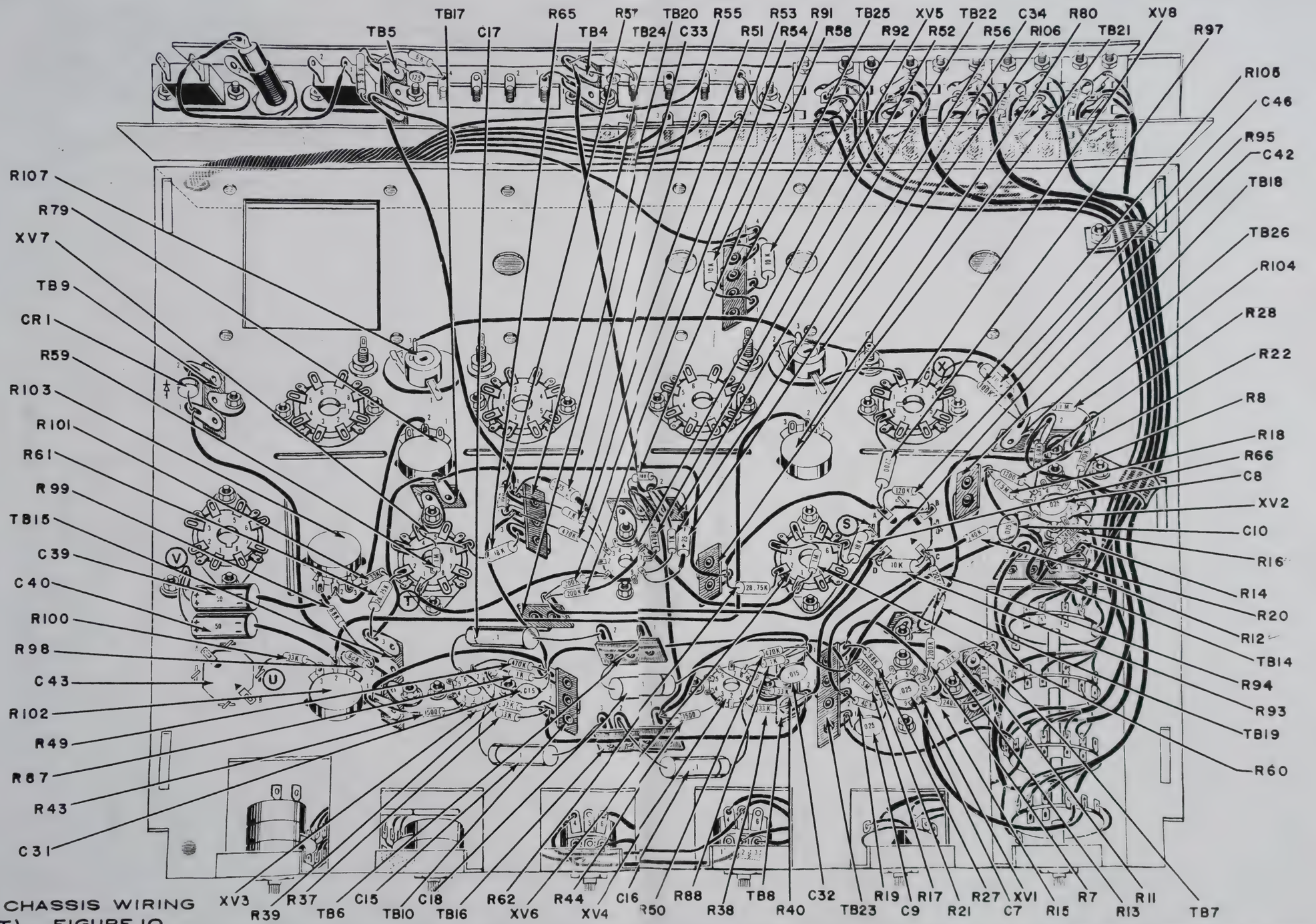
( ) 6. On printed circuit plate PC2, cut leads #2, #3 and #6 to 1/2"; cut leads #1, #4 and #7 to 1 3/4" and cover each of these with a 1 1/2" piece of spaghetti. Cut lead #5 to 1". Place the plate against R46 as shown. Connect lead #2 to R46-4 (S1), lead #3 to R46-5 (S1), lead #6 to R46-6 (S1), lead #7 to R48-4 (S2), lead #1 to R48-6 (S2), lead #5 to TB13-2 (S2) and lead #4 to R48-5 (S1).

( ) 7. Connect a 4" piece of white wire from S7-6 (S1) to S6-1 (C).

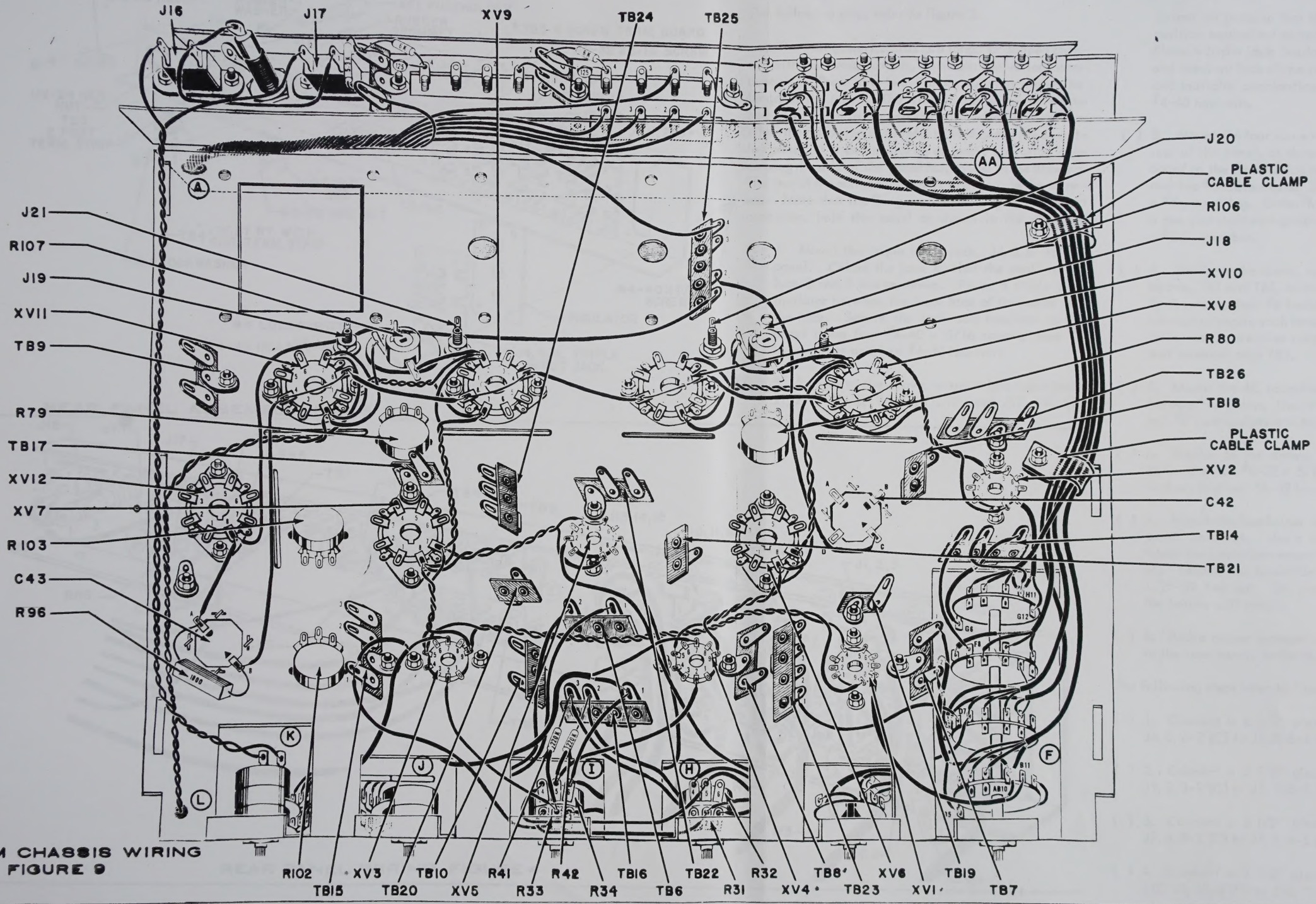
( ) 8. Connect a 4" piece of grey wire from S7-12 (S1) to S6-4 (C).

( ) 9. Cut all leads on two .015mfd (15K or 15,000 mmf) disc capacitors, C23 and C24, to 1/2". Connect C23 from S6-5 (S2) to S6-4 (S3). Connect C24 from S6-2 (S2) to S6-1 (S3).

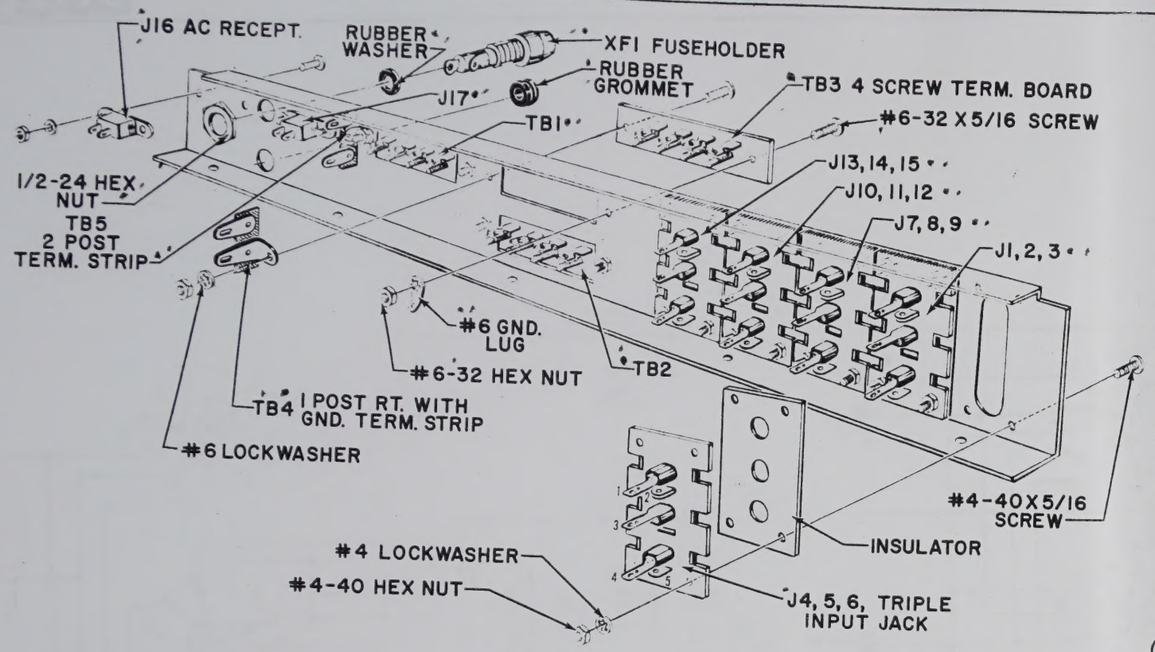
( ) 10. Cut all leads on two .009mfd (9K or 9000mmf) disc capacitor, C29 and C30, to 1/2". Connect C29 from S6-11 (S2) to S6-10 (S2). Connect C30 from S6-8 (S2) to S6-7 (S2).



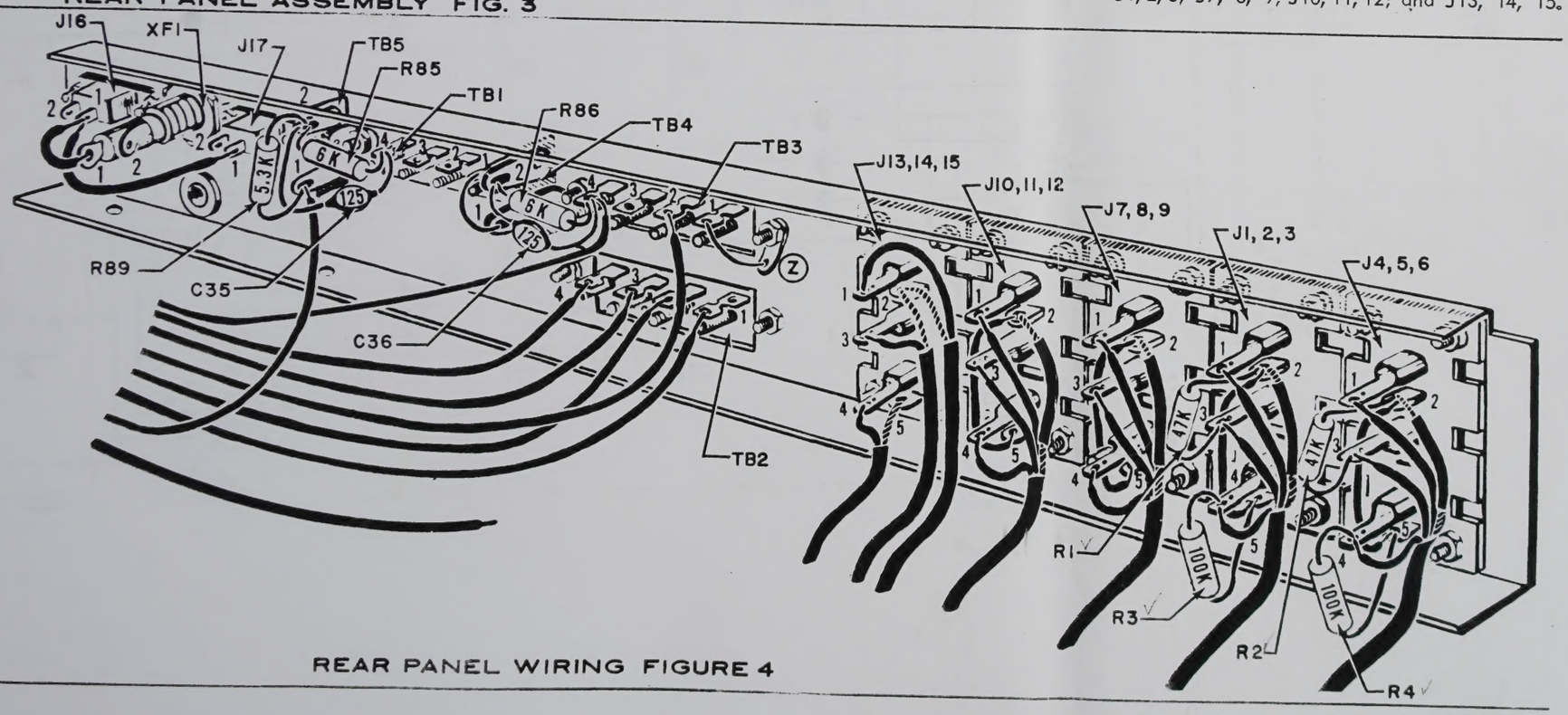
BOTTOM CHASSIS WIRING (CON'T.) FIGURE 10



OTTOM CHASSIS WIRING
FIGURE 9



REAR PANEL ASSEMBLY FIG. 3



REAR PANEL WIRING FIGURE 4

The following steps refer to figure 3.

The rear panel consists of a long "U" shaped channel with numerous cutouts, to mount the various components. There are two flanges running along the length of the panel. The wide flange is considered the bottom in this drawing and the narrow flange is the top. When the following steps refer to the front of the mounting panel, it is describing an assembly operation concerning the side of the panel facing you in the drawing. The rear of the panel faces away from you, in the drawing. Note that the flanges are towards you. To avoid confusion, hold the panel as shown in the drawing.

( ) 1. Mount the triple input jack, J4, 5, 6, to the panel. Orient the jack so that the small solder lugs 2 and 5 are as shown. Place a triple jack insulator between the front face of the panel and the jack. Secure the jack and insulator to the panel using four #4-40 x 5/16 screws, four #4 lockwashers and four #4-40 hex nuts.

( ) 2. Similar to the above, mount triple input jacks J1, 2, 3; J7, 8, 9; J10, 11, 12; and J13, 14, 15. Orient all jacks so that the solder lugs are in the position equivalent to that shown for jack J4, 5, 6. Place a triple jack insulator between each jack and the front face of the panel. Secure each jack and insulator combination to the panel using four #4-40 hex nuts.

( ) 3. Mount the four screw terminal board TB3 to the rear of the panel, as shown. Secure the terminal board to the panel using two #6-32 x 5/16 screws and two #6-32 hex nuts. Under one hex nut, place a #6 ground lug. Under the second hex nut, place a one post right with ground terminal strip TB4 and a #6 lockwasher.

( ) 4. Similar to the above, mount four screw terminal boards, TB1 and TB2, as shown. Use two #6-32 x 5/16 screws, two #6 lockwashers and two #6-32 hex nuts to secure each terminal board to the panel. Under one lockwasher used on TB1 place the two post terminal strip TB5.

( ) 5. Mount the AC receptacle J16 to the front of the panel as shown. Use two #6-32 x 5/16 screws, two #6 lockwashers and two #6-32 hex nuts.

( ) 6. Similar to the above, mount AC receptacle J17. Use two #6-32 x 5/16 screws, two #6 lockwashers and two #6-32 hex nuts.

( ) 7. Mount the fuseholder XF1 to the rear of the panel, as shown. Use a thin rubber washer between the fuseholder mounting flange and the panel. Secure the fuseholder to the panel using a 1/2"-32 hex nut. Do not tighten too much or the holder will crack.

( ) 8. Push a rubber grommet into the remaining hole in the rear panel, under the fuseholder.

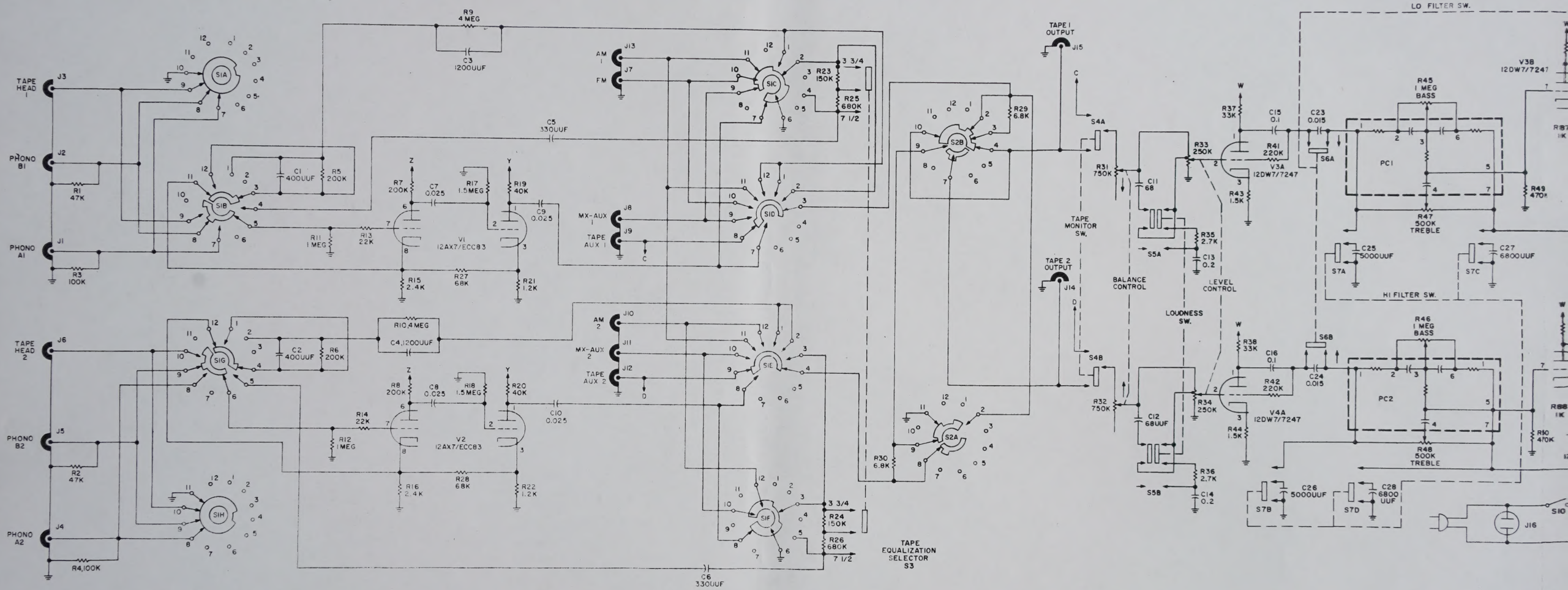
The following steps refer to figure 4.

( ) 1. Connect a 2 1/2" piece of black wire from J4, 5, 6-2 (C) to J4, 5, 6-5 (C).

( ) 2. Connect a 2 1/2" piece of black wire from J1, 2, 3-2 (C) to J1, 2, 3-5 (C).

( ) 3. Connect a 2 1/2" piece of black wire from J7, 8, 9-2 (C) to J7, 8, 9-5 (S1).

( ) 4. Connect a 2 1/2" piece of black wire from J10, 11, 12-2 (C) to J10, 11, 12-5 (S1).


TAPE HEAD 1
J3
PHONO B1
J2
PHONO A1
J1
R1 47K
R3 100K
S1A
S1B
C1 400UUF
R5 200K
R11 1 MEG
R13 22K
R9 4 MEG
C3 1200UUF
C5 330UUF
Z
R7 200K
C7 0.025
R17 1.5MEG
Y
R19 40K
C9 0.025
V1 12AX7/ECC83
R15 2.4K
R27 68K
R21 1.2K
AM 1
FM
J13
J7
S1C
R23 150K
3 3/4
R25 680K
7 1/2
MX-AUX 1
TAPE AUX 1
J8
J9
S1D
TAPE HEAD 2
J6
PHONO B2
J5
PHONO A2
J4
R2 47K
R4,100K
S1G
S1H
C2 400UUF
R6 200K
R10,4 MEG
C4,1200UUF
R8 200K
C8 0.025
R18 1.5MEG
R20 40K
R14 22K
R12 1 MEG
C10 0.025
V2 12AX7/ECC83
R16 2.4K
R28 68K
R22 1.2K
C6 330UUF
AM 2
MX-AUX 2
TAPE AUX 2
J10
J11
J12
S1E
S1F
R24 150K
R26 680K
7 1/2
R29 6.8K
S2B
R30 6.8K
S2A
TAPE EQUALIZATION SELECTOR S3
TAPE 1 OUTPUT
J15
TAPE 2 OUTPUT
J14
TAPE MONITOR SW.
S4A
S4B
R31 750K
R32 750K
C11 68
C12 68UUF
S5A
S5B
BALANCE CONTROL
R33 250K
R34 250K
R35 2.7K
C13 0.2
R36 2.7K
C14 0.2
LEVEL CONTROL
LOUDNESS SW.
R37 33K
R38 33K
C15 0.1
C16 0.1
R41 220K
R42 220K
V3A 12DW7/7247
V4A 12DW7/7247
R43 1.5K
R44 1.5K
C23 0.015
C24 0.015
S6A
S6B
LO FILTER SW.
HI FILTER SW.
PC1
PC2
R45 1 MEG BASS
R46 1 MEG BASS
R47 500K TREBLE
R48 500K TREBLE
R49 470K
R50 470K
V3B 12DW7/7247
V4B 12DW7/7247
C25 5000UUF
C26 5000UUF
C27 6800UUF
C28 6800 UUF
S7A
S7B
S7C
S7D
S8
J16